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YEAR BOOK

OF THE

MICHIGAN COLLEGE OF MINES

1901–1902.

ANNOUNCEMENT OF COURSES FOR 1902–1903.

HOUGHTON, MICHIGAN.

HOUGHTON, MICH., U. S. A.
PUBLISHED BY THE COLLEGE,
MAY, 1902.

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PRESSES OF THE MINING GAZETTE CO.,
1902.

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A BOOKLET OF VIEWS WILL BE ISSUED DURING THE YEAR SHOWING THE VARIOUS COLLEGE BUILDINGS AND ILLUSTRATING THE PRACTICAL WORK OF THE INSTITUTION.

Michigan College of Mines

GENERAL STATEMENT

The Michigan College of Mines was established by an act of the Legislature of 1885. The Act was entitled: "An Act to establish and regulate a Mining School in the Upper Peninsula." The Act vested the government of the institution in a Board of Control of six members appointed by the Governor of the State. Two members of the Board are appointed each alternate year to serve six years.

Sec. 5 provided that; The course of instruction shall embrace geology, mineralogy, chemistry, mining, and mining engineering, and such other branches of practical and theoretical knowledge as will, in the opinion of the board, conduce to the end of enabling the students of said institution to obtain a full knowledge of the science, art, and practice of mining, and the application of machinery thereto.

The school was opened for the reception of students Sept. 15, 1886. Its establishment and the earlier appropriations for it, were to a very large extent due to the great interest, the foresight and the energy displayed on its behalf by the late Jay A. Hubbell, of Houghton. He donated a large portion of the site occupied by the College, and during his life spared no effort to further its aims, or to help it toward prosperity.

It will be seen that the institution is closing its 16th year, yet it can point to successful graduates in almost every mining district of North America. Most of its students have been from Michigan, since it is a Michigan institution, yet it has trained men from all parts of the United States, and from a number of foreign countries in both hemispheres.

The concentration of effort on the training of Mining Engineers, the location of the College in a district where its students live in a mining atmosphere, together with its special methods of instruction

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used in the gold and silver mines of the United States. It is far more than double the horse power employed at the World's Columbian Exposition at Chicago in 1893.

Beside the plants at the mines there are the necessary docks, railroads, mills and smelters. To all the student has access, and he is required under the direction and supervision of his instructors to visit and inspect these plants and their operations at proper times during his study here. By being in such a district and being required to use its opportunities as he is, the student breathes from his arrival an atmosphere in entire harmony with his present and future work. He is continually inspired by observation of and contact with men who have achieved success, in the line for which he is training. This location together with the practical methods of training employed, account for the remarkable fact that of 178 men graduated up to this time, but three have left engineering for other pursuits.

The methods of instruction include the ordinary lecture, textbook and recitation work, supplemented in every department by problems drawn as far as possible from actual practice. Because the successful engineer must be a man whose judgment of *things* is well developed, laboratory methods of instruction are given great prominence. These include the trips of inspection to the mining plants in the vicinity, and the field and laboratory courses in which the student works with his own hands rather than watches the operations of some one else. In much the same way as the clinic serves to instruct the medical student, the inspection trips under the charge of the professor serve to train the mining student. But the medical student if he can, gets in addition to his clinics training in a hospital where under the proper supervision he begins actual practice. So the student taking a mining engineering course should have his actual practice in the field or in properly arranged laboratories. This the College endeavors to give.

The facilities afforded for inspection trips and field work by the location of the College have already been mentioned. It is obvious that actual commercial operations, such as are witnessed on the inspection trips to the mining plants, afford most forceful illustrations of the applications of principles which may be presented in textbook or lecture. Necessarily also the nearer the field or laboratory practice is made to conform to commercial requirements, the more

tions governing the choice of courses under this system are given with other regulations of the College on a subsequent page.

The methods outlined above are not schemes which have been carelessly thought out and hastily adopted. They have developed slowly in the earnest effort of those interested in, and responsible for the institution to solve the problems presented to it, and to build up an efficient system of training mining engineers. Up to the present time they have stood the test of use very satisfactorily.

BOARD OF CONTROL OF THE MICHIGAN COLLEGE OF MINES

	TERM EXPIRES.
William Kelly, Vulcan, - - - - - - -	June 9, 1903
Elbridge Gerry Brown, Calumet, - - - -	June 9, 1903
Walter Fitch, Beacon, - - - - - - - -	June 9, 1905
Horatio Stuart Goodell, Houghton, - - - -	June 9, 1905
Hon. John Monroe Longyear, Marquette, - -	June 9, 1907
Hon. Thomas Bree Dunstan, Hancock, - - -	June 9, 1907

President of the Board of Control................WALTER FITCH
Secretary of the Board of Control..........FRED WALTER McNAIR

RALPH CLARK WORKS, B.S. (Michigan College of Mines),
Instructor in Chemistry and Metallurgy.

ELMER D. GRANT, B.A. (Colgate University). M.A. (University of Chicago),
Instructor in Mathematics and Physics.

NATHAN SANFORD OSBORNE, **E.M. (Michigan College of Mines),**
Instructor in **Mathematics and Physics.**

FREDERICK EUGENE WRIGHT, **PH.D., (University of Heidelberg),**
Instructor in **Petrography.**

WILLIAM ALFRED TUCKER, S.B. (**Massachusetts Institute of Technology**),
Instructor in Mining Engineering.

HENRY MAX GOETTSCH, M.S. (State University of Iowa),
Instructor in Chemistry and Metallurgy.

CHARLES DUVAL HOHL, B.S. (Michigan College of Mines),
Instructor in Mathematics and Physics.

ROBERT WARING WIELAND, B.S. (Pennsylvania State College),
Assistant in Mineralogy.

ALEXANDER McROBBIE,
Assistant in Civil and Mining Engineering.

LOUIS CHESTER PEARCE, B.S., E.M., (Michigan College of Mines),
Assistant in Mechanical and Mining Engineering.

GEORGE A. ARNOLD, B.S., E.M. (Michigan College of Mines),
Assistant in Mechanical and Mining Engineering.

THOMAS LEBRETON MACLEOD,
Assistant in Physics and Mining Engineering.

CARROLL RALPH FORBES,
Assistant in Mechanical Engineering and Physics.

CHARLES WILLIAM WRIGHT,
Assistant in Geology and Mineralogy.

KNOWLES BURDETTE SMITH, B.S., E.M. (Michigan College of Mines),
Assistant in Geology and Mineralogy.

ANTHONY FRED BENSON,
Assistant in Chemistry.

FRANK BROWN WILSON,
Assistant in Chemistry

OTHER OFFICERS

HENRY GIBBS,
Purchasing Agent and Supply Clerk.

MISS CLARA PENBERTHY,
Stenographer.

HARRY SHARP,
Accountant.

ANTON LANGE WINCKLER,
Engineer.

MAXIME MORIN,
Carpenter.

FREDERICK CHARLES STRASSER,
Janitor.

WILLIAM JOSEPH HILLENBRAND,
Janitor of Chemical Laboratories.

FACULTY

Fred Walter McNair, President.

George Augustus Koenig.

Fredcrick William Sperr.

Ozni Porter Hood.

Arthur Edmund Seaman.

James Fisher, Jr.

Frances Hanna Scott, Secretary.

NAME. OCCUPATION. ADDRESS.

BEEN, JOHN THEODORE, B. S., E. M., 1896. Explorer with E. J. Longyear, Hibbing, Minn. Draughtsman, Boston and Montana Consolidated Copper and Silver Mining Co. Assistant Engineer, Butte and Boston Mining Co., Butte, Mont. Engineer, Compania Minera de Penoles. *Mapimi, Durango, Mex.*

BLACKWELL, FRANK, B. S., 1897, E. M., 1898. Chemist, Commonwealth Mine, Commonwealth, Wis. Mining Engineer, Oliver Mine, Mountain Iron, Minn. Mining Engineer, Vermilion Iron Range, for Oliver Iron Mining Co. *Ely, Minn.*

BLAIR, ARTHUR EDDLMUND, E. M., 1898. Engineer and Chemist, Commonwealth Iron Co., Commonwealth, Wis. Engineer and Draughtsman Washoe Copper Co., Anaconda, Mont. Engineer and Chemist, Carissa Gold Mining Co., South Pass City, Wyo. Mining Engineer with Chas. W. Clark, Butte, Mont. Mining Engineer, Boston-Montana Mining Co., Butte, Mont. *Butte, Mont.*

BOSSERT, OTTO HENRY, E. M., 1891. Student at the Bergakademie, Freiberg, Saxony. Assayer, Bingham Canyon, Utah. U. S. Deputy Mineral Surveyor and Mining Engineer, Salt Lake City, Utah. Superintendent, Bullion King Mining and Metallurgical Co., Idaho Springs, Colo. Superintendent, Raven Mining Co., Uintah Indian Reservation, Colton, Utah. *Colton, Utah.*

BOTSFORD, CHARLES WARD, B. S., 1900. Engineer, Trimountain Mining Co. Engineer, Trimountain Mill. Engineer, Centennial Copper Co. *Calumet, Mich.*

BOTSFORD, FRANK PHILIP, E. M., 1900. Assistant Engineer, Atlantic Mining Co., Redridge, Mich. Engineer, Hobart Iron Co., McKinley, Minn. *McKinley, Minn.*

[redacted]

NAME.	OCCUPATION.	ADDRESS.

BRENNON, JOHN CLARK, B. S., 1899, E. M., 1900. Student, Michigan College of Mines. Assistant Engineer, Grand Central Mining Co. Ltd. Mining Engineer, Grand Central Mining Co., Ltd., Sonora, Mex.
Torres, Sonora, Mex.

BROWN, WILLIAM FRANCIS, E. M., 1898. Assayer and Assistant Engineer, Mexican Gold and Silver Recovery Co. Ltd., in charge of Cyanide Department, Mexican Gold and Silver Recovery Co. Ltd., Tlalpujahua, Michoacan, Mex. *Tlalpujahua, Michoacan, Mex.*

BURNHAM, MATHER HOWARD, B. S., 1898. Mining Engineer, Cape Town, S. A. *Cape Town, S. A.*

BURR, FLOYD LYMAN, B. S., E. M., 1900. Chemist at Mansfield Mine, De Soto Iron Co., Crystal Falls, Mich. Mining Engineer and Geologist, Arringdale Mine, Virgilina, Va. Assistant Engineer, Penn Iron Mining Co., Vulcan, Mich. *Vulcan, Mich.*

BURRALL, FREDERICK PECK, E. M., 1894. Topographer, Michigan Geological Survey, Houghton, Mich. Assistant in Chemistry, Michigan College of Mines. Engineer for E. J. Longyear, Hibbing, Minn. Mining Engineer for R. M. Bennett, Custer, S. D.; Fort Steele, B. C., and Ashland, Oregon. Mining Engineer, The Pacific Syndicate, Bisbee, Ariz. Mining Engineer and Assistant Superintendent, Ashland and Mattern Gold Mines, Ashland, Oregon. Mining Engineer and Chemist for the Mexican Gold and Silver Recovery Co., Mexico City. Chief Chemist, Tlalpujahua Department, Mexican Gold and Silver Recovery Co., Tlalpujahua, Michoacan, Mex. Director Local, La Compania Minera Buenavista y Anexas, S. A. La Yesca, Territorio de Tepic, Mexico. *La Yesca, Territorio de Tepic, Mex*

NAME. OCCUPATION. ADDRESS.

CAMERON, WILLIAM McCALLUM, B. S., E. M., 1895. Assistant Engineer with the Union Leasing and Mining Co., Leadville, Colo. Mining Engineer Small Hopes Consolidated Mining Co., Coronado Mining Co., and Union Leasing and Mining Co., Leadville, Colo. Superintendent of the Small Hopes Consolidated Mining Co., Leadville, Colo. *Leadville, Colo.*

CARPENTER, ALVIN BACON, B. S., E. M., 1896. Engineering Work, Cripple Creek, Colo. Assayer, Victor, Colo. Mining Engineer, Gold Hill Mining Co., Los Tarros, Mex. Mining Engineer and Chemist for the Mexican Gold and Silver Recovery Co., Ltd., of London, City of Mexico, Mex. Manager, The Mexico Venture Syndicate Ltd., El Oro, State of Mexico, Mex., and The Borda Mines, Tlalpujahua, Mex.
El Oro, State of Mexico, Mex.

CAVAZOS, AMADO, JR., E. M., 1898. With Ca. Minera del Saltillo, Saltillo, Mex. Construction work for the Coahuila y Pacifico R. R. Co. *Saltillo, Coahuila, Mex.*

CHURCH, GEORGE BACHELOR, E. M., 1893. Civil Engineer, Chicago, Ill. Miner, Comstock Silver Mine, Park City, Utah. Mining Engineer and Foreman, Comstock Silver Mine. Mining Engineer and Chemist, Daly West Mine, Park City, Utah. U. S. Deputy Surveyor, Park City, Utah. Mining Engineer, Nelson, B. C.
Nelson, B. C.

CLARK, ALONZO WEBSTER, JR., B. S., E. M., 1898. With U. S. Board of Engineers on Deep Waterways, Detroit, Mich. With Atlantic Mining Co., Atlantic Mine, Mich. Mining Engineer, Genoa and Elba Mines, Sparta, Minn. With Tennessee Coal and Iron Co., Nashville, Tenn.
Nashville, Tenn.

NAME. OCCUPATION. ADDRESS.

CROZE, WALTER WILFRED JOSEPH, B. S., 1889. Assistant Mining Engineer, Cleveland Mine, Ishpeming, Mich. Chief Mining Engineer, Jackson Iron Co., Negaunee, Mich. Mining Engineer, Houghton, Mich. Mining Engineer, Canton Mine, Biwabic, Minn. Superintendent of work on Magnolia Claim, Cripple Creek, Colo. Consulting Mining Engineer (Croze & Dengler), Denver, Colo. Mining Engineer, Oliver Iron Mining Co.'s Tilden Mine, Bessemer, Mich. Mining Engineer, Oliver Iron Mining Co.'s Norrie Mine, Ironwood, Mich. Superintendent of Explorations, Oliver Iron Mining Co. on Vermilion Range. *Ely, Minn.*

CUMINGS, WILLARD LAWSON, B. S., (Michigan Agricultural College), E. M., 1900. Instructor in Petrography, Michigan College of Mines, Houghton, Mich. Assistant on Hillyer Geological Survey, Northern Minnesota. Geologist and Draughtsman Donora Mining Co., Duluth, Minn. Assistant to Mr. W. N. Merriam, Geologist, U. S. Steel Corporation, Duluth, Minn.
Duluth, Minn.

DANIELL, JOHN, B. S., 1897; E. M., 1898. Mining Engineer Franklin Mining Co., Hancock, Mich.
Calumet, Mich.

DANIELL, JOSHUA, B. S., 1890. Assistant Mining Engineer, Tamarack, Osceola and Kearsarge Mines, Opechee, Mich. Assayer, Boston and Montana Consolidated Copper and Silver Mining Co., Great Falls, Mont. Blast Furnace foreman, Boston and Montana Consolidated Copper and Silver Mining Co.
37 Rue du Dragon, Paris, France.

DAVIS, CHARLES STANLEY, E. M., 1899. Assistant Mining Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Mining Engineer, Mexican Gold and Silver Recovery Co. Ltd., of London.
El Oro, Tultenango, Mex.

War Eagle Mining and Development Co. Ltd., and Center Star Mining Co., Ltd., Rossland, B. C. Chief Engineer, Oliver Iron Mining Co. Chief Engineer for the Iron Mines of the United States Steel Corporation. *Duluth, Minn.*

DuBois, Wilbur Fisk, B. S., 1896. Assistant Mining Engineer and Surveyor, E. J. Longyear, Hibbing, Minn. Assayer, firm of Dubois & Munroe, Ymir, B. C. Manager Enterprise Mine, Ten Mile, B. C. Manager, Arlington Mines, Ltd., Slocan City, B. C. *Slocan City, B. C.*

Dunn, Bird Wallace, B. S., E. M., 1900. Reporting Engineer, Parral, Mexico. *Houghton, Mich.*

Durfee, Elmer Whipple, E. M., 1894. Superintendent of Concentrating Mill and R. E. Lee Silver-Copper Mine, Lordsburg, New Mex. Superintendent of the New Mexico and Arizona Smelter Concentrator, Washington, Ariz. Superintendent, Mechanical Department Baldwin, Tuthill & Bolton, Manufacturers of Saw Fitting Machinery, Grand Rapids, Mich. Superintendent of Sedalia Copper Co., Salida, Colo. *Salida, Colo.*

Dyer, Holmes Hayward, E. M., 1895. Inspecting Engineer, Ishpeming Sewer System. Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Cos., Ishpeming, Mich. Electrical Engineer and Superintendent of Public Works, Stanton, Mich. Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Cos. Chief Mining Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Manager, Huron Iron Co., Crystal Falls, Mich. Superintendent, Colonial Mining Co., Biwabik, Minn. *Biwabik, Minn.*

NAME. OCCUPATION. ADDRESS.

FARWELL, PAUL, B. S., 1889. Draughtsman, Colorado and Northeastern Railway, Pueblo, Colo. Assistant Chemist, Philadelphia Smelting and Refining Co., Pueblo, Colo. Assayer and Chemist, Santa Rosa Consolidated Mining and Smelting Co., Musquiz, Coahuila, Mex. Chemist, Anaconda Mining Co., Anaconda, Mont. Assayer, A. M. Donaldson & Co., Denver, Colo. Assayer in charge, Assay Office of M. D. Corrigan, Denver, Colo. Custom Assay Office; Reporting Engineer, Laramie, Wyo. *Laramie, Wyo.*

FAY, LOUIS DOUGLAS, E. M., 1898. Mining Engineer, Los Angeles, Cal. Manager of Exploration and ore tests on Gold Bronze and other properties in Vanderbilt Mining District, San Bernardino Co., Cal. Assistant Millman and Assayer, Arizona and New England Gold M. and M. Co., Pyramid, Ariz. Superintendent, Red Belt Mine, Homestake, Nex. *Los Angeles, Cal.*

FECHHEIMER, SOLOMON, M. E. (Stevens Institute of Technology), B. S., E. M., 1896. Mining Engineer, Eureka, Utah. U. S. Deputy Mineral Surveyor, Salt Lake City, Utah. Mining Engineer, Dyea, Alaska. Assistant to the Chief Engineer of Schwarzschild & Sulzberger Co. of New York, Chicago and Kansas City. *Chicago, Ill.*

FESING, HERMAN WILLIAM, B. S., E. M., 1890. Assistant City Engineer, Iron Mountain, Mich. Mining Engineer and Chemist, Hamilton Ore Co., Iron Mountain, Mich. Civil and Mining Engineer, Everett, Washington. Fee-Owner's Agent, Dunn, Crystal Falls and Columbia Mines, Crystal Falls, Mich. Chemist in charge of the Experimental Laboratory of John T. Jones, Iron Mountain, Mich. Assistant Superintendent, Manufacture and Introduction of Explosives, Summit Hill. Mining Engineer, Dallas, Tex. Draughtsman, Portage Lake Foundry Machine Co. Timberman, Calumet and Hecla

NAME.	OCCUPATION.	ADDRESS.

FORMIS, ANDRE, B. S., 1899, E. M., 1900. Assistant Mining Engineer, Lake Superior Iron Co., and City Engineer, Ishpeming, Mich. *Ishpeming, Mich.*

FRANKE, EMIL ARTHUR, B. S., 1899, E. M., 1900. Instructor in Chemistry and Metallurgy, Michigan College of Mines, Houghton, Mich. Assayer and Cyanide Chemist, El Oro Mine and Railway Co., El Oro, Mex. Assayer and Clerk, Guggenheim Ore Buying Agency, Catorce, San Luis Potosi, Mex. Chemist and Cupola Foreman, Featherstone Foundry and Machine Co., Chicago, Ill. Mining Engineer and Chemist, The Elizabeth Mining Co., Keystone, So. Dak. Mining Engineer, Prescott, Ariz. *Prescott, Ariz.*

GILCHRIST, HUGH MCWHURR, E. M., 1900. With the Southern Smelting Co. Engineer, with The Empire and Alden Coal Companies, Wanlock, Ill. *Wanlock, Ill.*

GILLIES, DONALD, E. M., 1893. Assistant Assayer of the Parrot Mining and Smelting Co., Butte, Mont. Assistant Assayer and Draughtsman, Montana Ore Purchasing Co., Butte City, Mont. Assayer Lost River Mining Co., Cliff, Custer Co., Idaho. Surveyor, Superintendent, W. A. Clark's properties, Butte City, Mont. Superintendent of Mines, Parrot Silver and Copper Co., Butte City, Mont. Secretary and General Superintendent Sioux Consolidated Mining Co., and Utah Consolidated Mining and Milling Co., Robinson, Juab Co., Utah. General Manager, Farrel Copper Co., Butte, Mont. *Butte, Mont.*

GOLDSWORTHY, JOHN MARTIN, B. S., 1900, E. M., 1901. Engineer, Pewabic Mining Co. *Iron Mountain, Mich.*

GOODALE, GEORGE SILAS, B. S., 1899, E. M., 1900. Student Michigan College of Mines. Chemist and Assistant Engineer, Norrie Mines, Ironwood, Mich. Engineer, Trimountain Stamp Mill, Beacon Hill, Mich. *Beacon Hill, (Houghton Co.), Mich.*

NAME. OCCUPATION. ADDRESS.

GRAVES, MACDOWELL, B. S., E. M., 1896. Superintendent, Occidental Mine, Telluride, Colo. Superintendent of Mines for M. D. Graves y Cia, Mexico, D. F. Ocotlan, Edo de Oaxaca, Mex. Consulting Engineer, La Cia. Mexicana Manufacturera de Barro.
Mexico City, Mex.

GREENE, FRED TURRELL B. S., E. M., 1897. Assistant Draughtsman and Surveyor, Boston and Montana, and Butte and Boston Mining Cos., Butte, Mont. Assistant Superintendent and Mining Engineer, War Eagle Consolidated Mining and Development Co., Ltd., and Center Star Mining Co., Ltd., Rossland, B. C. Geologist with Ananconda Copper Mining Co., Washoe Copper Co., Parrot Mining Co., Colorado Smelting and Mining Co., Butte, Mont. *Butte, Mont.*

HAAS, JACOB C., B. S., 1889; E. M., 1890. Civil Engineer. Penokee and Gogebic Consolidated Mining Co., Ironwood, Mich. Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. Mining Engineer, Skylark Mines, Marcus, Wash. Mining Engineer and Assayer. Midway, B. C. Mining Engineer, Midway, B. C. Mining Engineer, Greenwood, B. C., and Spokane, Wash. Mining Engineer, Spokane, Wash.
Spokane, Wash.

HAAS, NATHAN, E. M., 1898. Assistant Mining Engineer and Assayer, Quincy Mining Co., Hancock, Mich. Mining Engineer, Nelson, B. C. *Nelson, B. C.*

HARDENBURGH, LOUIS MARTIN, (A. B., Hillsdale, College), E. M., 1896. Instructor in Chemistry and Ore Dressing, Michigan College of Mines. Mining Engineer Pewabic Co., Iron Mountain, Mich. Superintendent, Odanah Iron Co., Hurley, Wis. *Hurley, Wis.*

NAME. OCCUPATION. ADDRESS.

HARRIS, HERBERT JEAN, (B. S., University of Wisconsin), E. M., 1894. Engineer, Illinois and Mississippi Canal. Engineer, Double Track Work, Madison Division, Chicago and Northwestern Railway. Assistant Engineer, C. & N. W. Ry., Evansville, Wis. Assistant Engineer, Union Pacific R. R., Kansas Division.
Kansas City, Mo.

HARRIS, JOHN LUTHER, B. S., 1888. Surveyor, Quincy and Torch Lake Railroad. Special course, Massachusetts Institution of Technology, Boston, Mass. Assistant, and later Chief Mining Engineer, Quincy Mine, Hancock, Mich. Assistant Superintendent Quincy Mine, Hancock, Mich. *Hancock, Mich.*

HARTMANN, FREDERICK WILLIAM, B. S., E. M., 1900. With James P. Edwards, City Engineer. Civil Engineering and Surveying Houghton, Mich. With R. C. Pryor, Surveying, Houghton, Mich. Assistant Engineer, Wolverine and Mohawk Mining Companies, Kearsarge, Mich. *Kearsarge, Mich.*

HAYES, RUPERT PRATT, B. S., E. M., 1901. County Surveyor and Engineer with Hunter Mining Co., Wallace, Idaho. Mining Engineer, Johannesburg, S. A.
London, Eng.

HERBERT, CHARLES ARTHUR, B. S., E. M., 1901. Assistant Engineer, Isle Royale Mining Co., Houghton, Mich. Engineer Chicago, Wilmington and Vermillion Coal Co., Chicago, Ill. *Streator, Ill.*

HILLYER, VIRGIL SERBING, E. M., 1899. With Chapin Mine, Iron Mountain, Mich. With Manila Iron Co., Iron Mountain, Mich. In charge of Geological and Topographical Survey in Northern Minnesota. Deputy Commissioner of Mineral Statistics for Michigan.
Iron Mountain, Mich.

NAME. OCCUPATION. ADDRESS.

HOPKINS, CLARENCE VICTOR, E. M., 1901. With V. S. Hillyer's Geological and Topographical Survey of Northern Minnesota. Mining Engineer, Gagnon Mine, Amalgamated Copper Co., Butte, Mont.
Butte, Mont.

HONNOLD, WILLIAM LINCOLN, E. M., 1895. Assistant Superintendent, Mahoning Ore Co., Hibbing, Minn. Superintendent of Mines, California Exploration Co., San Andreas, Cal. Consulting Engineer, The Consolidated Mines Selection Co., Ltd., 310 Pine St., San Francisco, Cal. Consulting Engineer, The Consolidated Mines Selection Company, Ltd., and Messrs. A. Dunkelsbuhler & Company, 3, Throgmorton Avenue, London, Eng. *Johannesburg, S. A.*

HOULE, ALBERT JOSEPH, B. S., E. M., 1896. Instructor in Civil and Mining Engineering, Michigan College of Mines. Engineer, Copper Range Mining Co., Houghton, Mich. Engineer, with J. M. Ellsworth & Co., Cleveland, Ohio. Mining Engineer, United Globe Mines, Globe, Ariz.
Globe, Ariz.

HOULE, JOSEPH ARTHUR, B. S., E. M., 1899. Metallurgist, Old Dominion Copper Mining and Smelting Co., Globe, Ariz *Globe, Ariz.*

IRVINE, GEORGE CHADWICK, B. S., 1901. Traveling Mineral Collector for The Department of Geology and Mineralogy, Michigan College of Mines.
Houghton, Mich.

JEFFS, LEWIS ALBERT, B. S., 1898; E. M., 1899. With Jeffs Land Co., Ltd., Rockland, Mich. Inspector of Mines for Ontonagon county. Assayer for The Ophir Mining and Milling Co., Stateline, Utah. Superintendent, The Ophir Mining and Milling Co., Managing Director and Superintendent of The Wolverine Mining Co., Park City, Utah. *Park City, Utah.*

NAME. OCCUPATION. ADDRESS.

JOHNSON, OSCAR MARTIN, B. S., E. M., 1901. Mining Engineer, Loretto Iron Co., Loretto, Mich.
Loretto, Mich.

JONES, MAURICE LINDLEY, E. M., 1894. Transit man for Government Engineers, Eastern Division, Hennepin Canal, Bureau, Ill. Inspector, Illinois and Mississippi Canal. Surveyor and Draughtsman, with W. H. Leffingwell, Civil and Mining Engineer, Cripple Creek, Colo. Mining Engineer Jones and Arnold.
Cripple Creek, Colo.

KENT, BAMLET, B. S., E. M., 1896. Inspector, United States Engineers, Portage Lake Ship Canals, Houghton, Mich.
Houghton, Mich.

KIRCHEN, JOHN GEORGE, E. M., 1894. Assistant Surveyor Trap Rock River Railroad, Assistant Mining Engineer, Quincy Mine, Hancock, Mich. Mining Engineer, Arcadian Copper Co., Arcadian Mine, Mich. Mining Engineer, Globe Engineering Co., San Francisco, Cal. Mining Engineer, Mountain Copper Co., Keswick, Cal.
Keswick, Cal.

KIRK, MARCUS EUGENE, E. M., 1893. Mining Engineer and Prospector, Aurania, Lumpkin Co., Ga. Electrical Engineer Missouri and Kansas Telephone Co., Kansas City, Mo. (*Deceased* 1899.)

KNIGHT, JOHN ALEXANDER, E. M., 1894. Chemist, Illinois Steel Co., Chicago, Ill. Assistant Engineer Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Assistant, Engineering Corps, Lake Shore and Michigan Southern, and Chicago, Rock Island and Pacific Railways, Track Elevation, Chicago, Ill. Mining Engineer, Huron Iron Co., Crystal Falls, Mich. Mining Engineer Crystal Falls Iron Mining Co., Crystal Falls, Mich. Mining Engineering, Corrigan & McKinney properties Menominee and Gogebic Ranges.
Crystal Falls, Mich.

NAME. OCCUPATION. ADDRESS.

KNOX, JOHN, B. S., E. M., 1899. Assistant Engineer, Fay Group of Mines, Calumet, Mich. Engineer, Trimountain and Elm River Mines. Engineer, Nickel Copper Co. of Ontario, Worthington, Ont. Engineer, Trimountain Mine. *Houghton, Mich.*

LAWTON, NATHAN OLIVER, B. S., 1891. Chief Mining Engineer Aurora Iron Mining Co., Palms Iron Mining Co., Comet Iron Mining Co., Superior Iron Mining Co., and Penokee and Gogebic Development Co. Chief Mining Engineer and Chemist, Aurora Iron Mining Co., and Ashland Iron Mining Co., Penokee and Gogebic Consolidated Mines, and City Engineer, Bessemer, Mich. Superintendent, Iron Belt Mining Co., Iron Belt, Wis. *Iron Belt, Wis.*

LEGGAT, ALEXANDER, B. S., E. M., 1901. Geologist, with V. S. Hillyer's Geological and Topographical Survey of Northern Minnesota. Assistant and Draughtsman in Geological Department of the Anaconda Copper Mining Co. Assistant, Engineering Department, Anaconda Copper Mining Co. *Butte, Mont.*

LONGYEAR, EDMUND JOSEPH, B. S., 1888. Assistant Michigan Geological Survey. Explorer, Mesabi Range, Minn. Superintendent of the Longyear and Bennett Iron Explorations on the Mesabi Range, Minn. Mining Engineer, Specialty, Development of Mesabi Iron Lands, Minn. *Hibbing, Minn.*

LYMAN, ROBERT, JR., B. S., E. M., 1900. Assistant Engineer, War Eagle and Centre Star Mining Cos., Rossland, B. C. *Rossland, B. C.*

MAAS, ARTHUR EUGENE, B. S., E. M., 1899. With J. M. Longyear, Marquette, Mich. Mining Engineer, Shannon Copper Co., Clifton, Ariz. *Negaunee, Mich.*

NAME. OCCUPATION. ADDRESS.

McCurdy, William Alexander, E. M., 1898. Chemist, Lake Superior Smelting Co., Dollar Bay, Mich. Assayer, Comaplix, B. C. Mining Engineer, Mass Consolidated Mines, Mass City, Mich. Engineer and Chemist, Mass Stamp Mill, Keweenaw Bay, Mich. *Houghton, Mich.*

McDonald, Erwin Huntington, E. M., 1893. Professor of Mining Engineering, College of Montana, Deer Lodge, Mont. U. S. Deputy Mineral Surveyor, Deer Lodge, Mont. Machinist, Anaconda Concentrator, Mont. City Engineer, Anaconda, Mont. *Anaconda, Mont.*

McDonald, Ronald H., B. S., 1895. Assistant Surveyor, Quincy and Torch Lake R. R., Hancock, Mich. Assistant County Surveyor, Houghton County. Assayer and Chemist, Tamarack-Osceola Manufacturing Co., Dollar Bay, Mich. Chemist and Assayer, Lake Superior Smelting Co., Hancock, Mich. Superintendent of Smelter for Helvetia Copper Co., Helvetia, A. T. Superintendent, Chippewa Copper Mine, Rockmont, Wis. *Rockmont, Wis.*

McDonald, William Neal, E. M., 1894. Practical Mining, National Mine, Ontonagon, Mich. Sub-Inspector, United States Engineers, Portage Lake Ship Canals, Houghton, Mich. Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. Assistant Surveyor, Isle Royale Co., Isle Royale, Mich. Assistant Surveyor, Atlantic and Salmon Trout River Railroad, Atlantic Mine, Mich. Assistant Surveyor, with J. P. Edwards, C. E., Houghton, Mich. Sub-Inspector, United States Engineers, Portage Lake Ship Canals. (*Deceased.*)

McFarlane, George Campbell, E. M., 1894. Mining Engineer, Lemhi Mining Co., Gibbonsville, Idaho. Mining Engineer, Idaho Gold Reduction Co. Mining Engineer, Bingham Placer Mining Co., Gibbonsville, Idaho.

NAME. OCCUPATION. ADDRESS.

Superintendent, Monolith Mining Co., Ltd., Shoup, Idaho. Superintendent, Exploration of the Tobico Coal Co. Lands, Bay City, Mich. Superintendent, Wenona Coal and Mining Co., Bay City, Mich. Superintendent, Sun Dance Mine, Prescott, Ariz. Engineer, Hecla Coal and Cement Co., Bay City, Mich.

Bay City, Mich.

MERCER, HARRY TALMAN, B. S., 1898 E. M., 1899. Instructor in Mining Engineering, Michigan College of Mines. Engineer, Centennial Mine, Calumet, Mich. Engineer for M. Van Orden, Houghton, Mich. Engineer, Allouez Mine, Allouez, Keweenaw Co., Mich.

Allouez, Mich.

MICHELSON, AXEL ESPERN, B. S., E. M., 1900. Engineer and Chemist, Huron Iron Co., Crystal Falls, Mich. Engineer, Bird Iron Co., Crystal Falls, Mich. Engineer and Assayer, The Tiewaukee Gold and Silver Mining Co., Bingham Canyon, Utah.

Bingham Canyon, Utah.

MIDDLEMISS, BRUCE ALBERT, B. S., E. M., 1901. Engineer and Chemist, Princeton Mine, Princeton, Mich.

Princeton, Mich.

MOORE, CARLTON FRANKLIN, E. M., 1894. Assistant in Chemistry, Michigan College of Mines. Instructor in Mechanical Engineering and Drawing, Michigan College of Mines. Draughtsman and later Assistant Superintendent Arcadian Copper Co., Arcadian Mine, Mich. Superintendent of erection in Lake Superior Copper District Wisconsin Bridge and Iron Co., Milwaukee, Wis.

Houghton, Mich.

MURRAY, JAMES JARDINE, B. S., E. M., 1898. Mining Engineer, Mountain Copper Co., Ltd., Iron Mountain, Shasta Co., Cal. Assistant Draughtsman, Mountain Copper Co., Keswick, Cal. Draughtsman and Engineer, Mountain Copper Co.'s Smelting Works, Keswick, Cal.

Keswick, Shasta Co., Cal.

NAME. OCCUPATION. ADDRESS.

MURRAY, ROBERT, JR., B. S., E. M., 1895. Mining Engineer and Chemist, Loretto Iron Co., Loretto, Mich. Mining Engineer for the Menominee Exploring Co., and Superintendent for the Canadian Explorations, Pickands, Mather & Co., Cleveland, Ohio. *Wa Wa, Ont.*

NEAL, ALVIN CAMPBELL, E. M., 1901. Mining Engineer, Cripple Creek, Colo. *Cripple Creek, Colo.*

NEEL, CARR BAKER, B. S., (University of Chicago), E. M., 1899. Assistant Manager, Sabina Mining Co., Sabina, via Quiriego, Sonora. Blast Furnace Foreman, Boston and Montnaa Smelter, Great Falls, Mont. Auditor, Boston-Wyoming Smelter, Power and Light Co., Grand Encampment, Wyoming. *Grand Encampment, Wyo.*

OKUBO, TOGO, B. S., 1899. Japanese Naval Inspector, title of Lieutenant, Sheffield, England. Professor in Mechanical Engineering, Tokio Higher Technological School, Tokio, Japan. Consulting Engineer of Negishi Rolling Mill, Tokio, Japan. Consulting Engineer of Southern Gold Mine, Mikawa, Japan. *Tokio, Japan.*

O'NEIL, FREDERICK WILLIAM, E. M., 1899. Assistant in Mechanical Engineering, Michigan College of Mines. Chief Engineer, Champion Copper Co., Painesdale, Mich. Chief Engineer and Supterintendent of Stamp Mill, Champion Copper Co., Painesdale, Mich. *Painesdale, Mich.*

ORR, JOHN FORREST, B. S., E. M., 1895. Mining Engineer, El Concheno, Mex. Professor of Mining Engineering, College of Montana, Deer Lodge, Mont. Assistant Superintendent and Chemist on Cyanide Plant, El Triunfo, B. C., Mex. Superintendent of Cyanide Plant, Ropes Gold Mine, Ishpeming, Mich., for Corrigan, McKinney & Co. *Minneapolis, Minn.*

NAME.	OCCUPATION.	ADDRESS.

PARNALL, WILLIAM EDWARD, B. S., 1888. Superintendent, Stamp Mill, National Mine, Ontonagon, Mich. Mining Engineer and Chemist, Champion Mine, Beacon, Mich. Electrical Engineering Courses in Cornell University, Ithaca, N. Y., and Massachusetts Institute of Technology, Boston, Mass. In charge of the Installation of the Electric Haulage Plant, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. In charge of the Installation work for the Morgan Gardner Electric Co., Chicago, Ill. Electrical Engineer for Osborne, Seager & Co., West Newton, Pa. Assistant Superintendent of the Tamarack Mine, Calumet, Mich. *Calumet, Mich.*

PEACOCK, DAN C., E. M., 1898. Chemist for Commonwealth Iron Co, Commonwealth, Wis. Mining Engineer, Champion Iron Co., Beacon, Mich. *Beacon, Mich.*

PEARCE, LOUIS CHESTER, B. S., E. M., 1901. Instructor in Department of Mechanical Engineering, Michigan College of Mines. *Houghton, Mich.*

PENBERTHY, JOHN EDWARD, B. S., 1899; E. M., 1900. Student, Michigan College of Mines. Assistant Mining Engineer, Atlantic Mine, Mich. Mining Engineer, Mass Mine, Ontonagon Co., Mich. *Mass City, Mich.*

PENHALLEGON, WILLIAM JAMES, B. S., E. M., 1900. Assistant Engineer, Calumet and Hecla Mining Co., *Calumet, Mich.*

PRYOR, REGINALD CHAPPLE, B. S., 1889. Assistant Civil Engineer, Isle Royale Land and Exploration Co., Isle Royale, Mich. Civil and Mining Engineer,, Houghton, Mich. *Houghton, Mich.*

RANDALL, HUNTLEY BURNHAM, B. S., E. M., 1899. Railroad Construction, Detroit and Northwestern Electric Ry. Assistant Superintendent and Assistant Mining Engineer, Jimulco Copper Mining Co., Jimulco, Mex. *Jimulco, Coahuila, Mex.*

NAME. OCCUPATION. ADDRESS.

RASHLEIGH, WILLIAM JOHN, B. S., 1896. Assistant Engineer and Surveyor, Boston and Montana Consolidated Copper and Silver Mining Co., Great Falls, Mont. Mining Engineer, Odanah Iron Co., Hurley, Wis.
Hurley, Wis.

REA, RICHARD WILLIS, B. S., E. M., 1900. Assistant Engineer, Atlantic and Baltic Mining Cos. Mining Engineer, Atlantic and Baltic Mining Cos., at Stamp Mills. Assistant Superintendent, Atlantic and Baltic Mining Cos. *Redridge, Mich.*

REEDER, EDWIN COLVILLE, B. S., E. M., 1901. Mining, Boston and Montana Mining Co., Butte, Mont. *Butte, Mont.*

REID, WILLIAM, B. S., 1888. Miner, Champion Mine, Beacon, Mich. Miner, Lake Superior Mine, Ishpeming, Mich. With R. J. Hosner, Romeo Door Hanger Co., Romeo, Mich. Conductor, West End Street Ry., Boston, Mass. Farmer, Lawtey, Florida. Clerk, Baltimore Dairy Lunch Co., Boston, Mass. Clerk, Canfield & Spier, Attorneys, Mt. Clemens, Mich. (*Deceased*, 1899.)

REMER, EMIL FREDERICK, B. S., E. M., 1900. Mining Engineer, Isle Royale Mining Co., Houghton, Mich.
Houghton, Mich.

REYNOLDS, FREDERICK LLEWELLYN, E. M., 1898. Chemist with Universal Fuel Co., Chicago, Ill. Chemist and Engineer, British Gold Mines of Mexico, Ltd., at Mina La Colorado. *Matape, via Ures, Mex.*

RICHARDSON, HENRY HARRISON, B. S., E. M., 1901 Assistant to Superintendent of Buildings, Michigan College of Mines. Assistant Superintendent, Pinto Creek Copper Co., Globe, Ariz. *Globe, Ariz.*

RIDLEY, FREDERICK WILLIAM, E. M., 1894. Assistant Mining Engineer, Calumet and Hecla Mining Co., Calumet, Mich. *Calumet, Mich.*

NAME. OCCUPATION. ADDRESS.

ROPES, LEVERETT SMITH, B. S., 1895. Explorer for Corundum, Messrs. Hamlin & Kline, Detroit, Mich. Assistant Mill Engineer, American Corundum Co., Franklin, N. C. General Mine and Mill Engineer, 1896. General Mine and Mill Engineering and Contracting, Franklin, N. C. General Engineering, Examining and Reporting on Gold Placer, Iron and Talc Properties, Murphy, N. C. Mining Engineering for Canadian Corundum Co., Ontario, Can. Superintendent, Canada Corundum Co's. Mines near Combermere, Can. Manager, Montana Corundum Co. Managing Director and Superintendent, Montana Corundum Co., Salesville, Mont. *Salesville, Mont.*

ROSE, ROBERT SELDEN, B. S., 1895; E. M., 1896. Mining Engineer, El Concheno, Mex. Assistant Engineer, D., S. S. and A. Ry, Superior, Wis. Superintendent, Construction of Ore Docks, L. S. and I. Ry., Marquette, Mich. Mining Engineer, Pioneer Iron Co., Ely, Minn. Assistant Superintendent, Holy Terror Mining Co., Keystone, S. D. Manager, Sunnyside Mining Co., Hill City, S. D. Superintendent, Consolidated Verde Mining and Milling Co., Cimarron, N. M. Mining Engineer, Marquette, Mich. *Marquette, Mich.*

ROURKE, JERRY, E. M., 1894. Civil and Mining Engineer, Hancock, Mich. Civil Engineer, Cripple Creek, Colo. Mining Engineer, Michigan Gold Mining and Milling Co., Gunnison, Colo. Mining Engineer, Cripple Creek Gold Mining and Development Co., Dubois, Colo. Mining Engineer with A. W. Clark, Butte, Mont.

Butte, Mont.

RUSSELL, EDWARD FRANCIS, B. S., E. M., 1896. Mining Engineer and Amalgamator, Little American Mine. Assayer and Chemist, Olive Mine Centre, Ontario, Can.

Harding, Minn.

NAME. OCCUPATION. ADDRESS.

ogy, Michigan College of Mines. Assistant Professor of Mineralogy and Geology, Michigan College of Mines, Professor of Mineralogy and Geology, Michigan College of Mines. *Houghton, Mich.*

SEEBER, REX ROBERT, B. S., E. M., 1899. Rodman, Copper Range Railroad Survey, Div. 5, Houghton, Mih. Mining Engineer and Chemist, American Mining Co. Assistant Engineer, Champion Copper Co., Painesdale, Mich., *Painesdale, Mich.*

SEELEY, BURTON TYNDALL, E. M., 1894. Assistant in Chemistry, Michigan College of Mines. Engineer of Gold Mine at El Concheno, Chihuahua, Mex. (*Deceased*, 1899.)

SHELDON, GEORGE ROPES, E. M., 1901. With V. S. Hillyer's Geological and Topographical Survey of Northern Minnesota. Engineer, Champion Stamp Mill, Freda, Mich. *Freda, Mich.*

SHIELDS, IRVING JAMES, B. S., 1900; E. M., 1901. Instructor in Mineralogy, Michigan College of Mines, and Assistant Commissioner of Mines and Minerals for Michigan, Buffalo Exposition. Assistant in Engineering Department, Lake Superior Smelting Co., Houghton, Mich. *Hancock, Mich.*

SHIELDS, JAMES WILSON, B. S., 1901. Assistant Superintendent, Tamarack and Osceola Consolidated Mining Co.'s Stamp Mill, South Lake Linden, Mich. *South Lake Linden, Mich.*

SLOCK, GEORGE, B. S., 1895; E. M., 1896. Assistant in Drawing, Michigan College of Mines. Inspector, L. S. & I. Ry., Marquette, Mich. Sub-Inspector, U. S. Engineers, Portage Lake Ship Canals, Houghton, Mich. Assistant Superintendent in Construction of Arcadian Stamp Mill, Hancock, Mich. Assistant Engineer, Tamarack and Osceola Consolidated Mines, Calumet, Mich. *Calumet, Mich.*

NAME. OCCUPATION. ADDRESS.

STRICKLAND, ROLAND HUGH, C. E., (Kingston Military College), B. S., E. M., 1897. Mining Engineer, Klondike, B. C. Superintendent, Koyukuk River Mining Co., Holland. *Bergman City, Alaska, U. S. A.*

STILLINGHAM, JOSEPH, JR., B. S., E. M., 1895. Examiner and Reporter of Gold Mines, Algoma District, Ontario, Canada. Bridge Builder on the Cleveland, Lorain and Wheeling R. R., Toledo Bridge Co., Toledo, Ohio. Mining Engineer, Cripple Creek, Colo. Chemist, Ingham Mine, Cripple Creek, Colo. Inspector, U. S. Engineer Corps (Lake Michigan Harbors.) Civil Engineer, Caslow and Slocan R. R.. Assistant Engineer, Deep Water Ways Survey, U. S. Engineer Corps. Seaman, U. S. Navy Spanish-American war, 1898. Designer and Draughtsman, Detroit Bridge and Iron Works, Detroit, Mich. Assistant Engineer, U. S. Engineer Corps. Isthmus Canal Commission, Darien Survey, Nicarauga. Constructing Engineer, The Solvay Process Co., Detroit, Mich. *Detroit, Mich.*

SUTTON, LINTON BEACH, B. S., 1890. Mining Engineer and Chemist, Volunteer Mine, Palmer, Mich. Chemist, Chapin Mining Co., Iron Mountain, Mich. Mining Engineer, Tremont Gold Mining and Milling Co., Gould, Mont. Mining Engineer, Chapin Mining Co., Iron Mountain, Mich. Mine Manager, Cape Town, S. A. *Cape Town, S. A.*

SUTTON, WILLIAM JOHN, B. S., E. M., 1898. Instructor in Mineralogy and Petrography, Michigan College of Mines. Geologist and Consulting Engineer, Esquimalt and Nanaimo Railway Co. *Victoria, B. C.*

THOMAS, JAMES ARTHUR, B. S., E. M., 1899. Transit man. Michigan Geological Survey, Houghton, Mich. Assistant Mining Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. *Globe, Ariz.*

NAME. OCCUPATION. ADDRESS.

UPHAM, WILLIAM ERASTUS, B. S., E. M., 1895. Engineer and Chemist, Canton Iron Co., Biwabik, Minn. Engineer, Mining Department, Kansas City Smelting and Refining Co., Sierra Mojada, Coahuila, Mex. Assistant Superintendent, Los Minas Tepezalanas, Tepezalas, Aguascalientes, Mex. Superintendent, Santa Gertrudis Mining Co., Baroteran, Coahuila, Mex.
Baroteran, Coahuila, Mex.

UREN, WILLIAM JOHN, B. S., 1888. Surveyor, Northern Michigan Railroad. Civil Engineer, Mineral Range and Hancock and Calumet Railroads. County Surveyor, Houghton County. Sub-Inspector, United States Engineers, Portage Lake Ship Canals. Draughtsman, Lake Superior Iron Works, Hancock, Mich. Assistant Superintendent, Elm River Copper Co. and Trimountain Mining Co. *Hancock, Mich.*

VALLAT, BENJAMIN WILLET, B. S., E. M., 1901. Assistant Engineer, Construction of Redridge Dam, Baltic Mining Co. Assistant Engineer, Copper Range R. R. Co. Mining Engineer, Donora Mining Co., Palmer, Mich.
Palmer, Mich.

VAN ORDEN, FRANK LYON, B. S., E. M., 1899. Mining Engineer, Wyandot Copper Co., Houghton, Mich. Superintendent, Wyandot Copper Co., Houghton, Mich.
Houghton, Mich.

WAKEFIELD, ARTHUR ALBERT, B. S., 1890. Mining Engineer, Fronteriza Silver Mining and Milling Co., Velardena, Mex. Mining Engineer, Hurley, Wis. Mining Engineer, Velardena, Mex. Mining Engineer, South McAlister, I. T. Mining Engineer, State of Chihuahua, Mex. Explorer, Gogebic Range. Engineer, Tilden Mine, Oliver Iron Mining Co., Bessemer, Mich. *Bessemer, Mich.*

WALKER, ELTON WILLARD, B. S., E. M., 1896. Assistant Engineer, Calumet and Hecla Mine, Calumet. Mining Engineer, Old Dominion Mining Co., Globe, Ariz. Mining Engineer, Tombstone Consolidated Mines, Tombstone, Ariz. *Tombstone, Ariz.*

NAME. OCCUPATION. ADDRESS.

WORKS, RALPH CLARK, B. S., 1900. Instructor in Chemistry, Michigan College of Mines. *Houghton.*

WRAITH, WILLIAM, E. M., 1894. Resident Engineer for Canon City Coal Co., Rockvale, Col. Engineer for Vulcan Fuel Co., at Newcastle, Col. Assistant Civil Engineer, Boston and Montana Consolidated Copper and Silver Mining Co., and Butte and Boston Mining Co. Civil Engineer, Boston and Montana Consolidated Copper and Silver Mining Co., and Butte and Boston Mining Co., Butte, Mont. Superintendent of Construction, Boston & Montana Consolidated Copper and Silver Mining Co., Butte, Mont. *Butte, Mont.*

ZERTUCHE, YGNACIO MARIA, B. S., E. M., 1896. Mining Engineer, San Francisco Mine, Conception del Oro, Mex. *Zacatecas, Zac. Mex.*

Present Location of Graduates

Alaska	2	Montana	11
Arizona	15	Ohio	1
British Columbia	6	Ontario	1
California	3	Oregon	1
Colorado	8	Russia	1
Cuba	1	South Africa	4
France	1	South Dakota	1
Honduras	1	Tennessee	1
Idaho	1	Utah	5
Illinois	4	Washington	2
Japan	1	West Africa	1
Kentucky	1	Wisconsin	5
Mexico	17	Wyoming	2
Michigan	63	Deceased	4
Minnesota	12		
Mississippi	1	Total	178
Missouri	1		

Admission to the College

1. Admission by Examination.

All students who desire to become candidates for a degree are admitted on examination in the following subjects:

English.—The examination in this subject is intended to test the candidate's ability to command good English. He will be required to write briefly on some subject assigned at the time.

Arithmetic and Metric System.

Bookkeeping.

Algebra, through Quadratic Equations.

Geometry—Plane, Solid and Spherical.

Physics.

Physical Geography or Elements of Astronomy.

2. Admission by Diploma.

Candidates who are graduates of the proper course of a high school accredited to this institution are admitted upon presentation of diploma, together with a record of the subjects pursued and grade obtained in each.

Application to be placed upon the accredited list may be made by the principal or superintendent of the school, who shall send to the secretary of the college a copy of the courses of study, and list of text-books employed. Copies of examinations which have been set, accompanied with papers which have been written by pupils in answer thereto, must also be forwarded to the College. The subjects covered by these papers must be not less than four, including Mathematics, Physics and one other science subject. If these are satisfactory, the school will be placed provisionally upon the accredited list. The college regards the work done by graduates as ultimately the genuine test of the character of the preparation given by the high school. If therefore the students accepted from such an accredited school shall be found to be deficient in preparation, the school must expect to be dropped from the list.

In case of any considerable change in the course of study or staff of instructors, the school is expected to notify the College, and if requested, it shall submit further evidence of the character of its work. Students of an accredited school who are not graduates can expect to enter the College by examination only.

The following institutions are now on the accredited list of the College:

Alma Academy, Alma, Mich.
Alpena High School.
Ann Arbor High School.
Atlantic High School.
Baraga High School.
Butte Business College, Butte, Mont.
Calumet High School.
Chicago Manual Training School, Chicago, Ill.
Cobb and Arms Classical School, Chicago, Ill.
Detroit Central High School.
Detroit Western High School.
Detroit School for Boys.
Duluth High School, Duluth, Minn.
Edgerton High School, Edgerton, Wis.
Escanaba High School.
Flint High School.
Gladstone High School.
Grand Rapids Central High School.
Hadley High School.
Hancock High School.
Houghton High School.
Hyde Park High School, Hdye Park, Chicago, Ill.
Ionia High School.
Iron Mountain High School.
Ironwood High School
Ishpeming High School.
Ithaca High School.
Janesville High School, Janesville, Wis.
Kalamazoo High School.
Kansas City Manual Training High School, Kansas City, Mo.
Lake Linden High School.

L'Anse High School.
Ludington High School.
Manistique High School.
Marquette High School.
Menominee High School.
Michigamme High School.
Milwaukee Academy, Milwaukee, Wis.
Milwaukee East Side High School, Milwaukee, Wis.
Milwaukee South Side High School, Milwaukee, Wis.
Milwaukee West Side High School, Milwaukee, Wis.
Morgan Park Academy, Morgan Park, Ill.
Negaunee High School.
Northwestern Military Academy, Highland Park, Chicago, Ill.
Norway High School.
Port Huron High School.
Reed City High School.
Republic High School.
Rockford High School.
Rutger's College Preparatory School, Princeton, N. J.
Saginaw East Side High School.
Saginaw West Side High School.
St. Johns Military Academy, Delafield, Wis.
San Antonio Academy, San Antonio, Tex.
Sault Ste. Marie High School.
Shattuck School for Boys, Faribault, Minn.
Three Rivers High School.

3. Graduates of Colleges.

Graduates of approved colleges are admitted upon presentation of their diplomas or certificates of graduation. Courses taken at the other institution which may be the equivalent of courses offered here, will be credited toward a degree, under the following conditions: After an informal discussion of the previous work, which must satisfy the instructors from whom credit is asked, as to its scope and thoroughness, provisional credits are given. If the student's subsequent work in this College is satisfactory, the provisional credits are made permanent; if unsatisfactory, the student is assigned to such courses as are necessary to make up the deficiencies.

cellent workers, and the College desires to extend to such persons every possible aid. It has assisted in this way numerous practical and active business men who have had years of previous experience, and it desires to continue a work from which valuable results have been obtained in the past.

B. PHYSICS.

The President, Professor Fisher, Messrs. Osborne, Grant, Hohl and Forbes.

B 1. Physics.

Twelve hours a week, twenty-one weeks. To count as eight-tenths of a credit. Must be preceded by, or accompanied with A 1 (Algebra) and A 2 (Plane Trigonometry). The President, Professor Fisher, Messrs. Osborne, Grant, Hohl and Forbes.

B 4. Physics.

Twelve hours a week, twelve weeks. To count as five-tenths of a credit. Must be preceded by B 1 (Physics). The President, Professor Fisher, Messrs. Osborne, Grant, Hohl and Forbes.

B 2. Physical Measurements.

Twenty-four hours a week, five weeks. To count as four-tenths of a credit. Must be preceded by B 1 and B 4 (Physics). The President and Professor Fisher.

B 5. Light.

Six hours a week, twelve weeks. To count as two-tenths of a credit. Must be preceded by B 1 and B 4 (Physics). The President, Professor Fisher and Mr. Osborne.

B 3. Electrical Measurements.

Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by C 1 (Analytic Mechanics). The President and Mr. Osborne.

C. MECHANICS.

The President, Professor Fisher, Messrs. Osborne and Grant.

C 1. Analytic Mechanics.

Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by, or accompanied with, A 5 (Calculus): Professor Fisher, Messrs. Osborne and Grant.

C 2. Analytic Mechanics.

Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by C 1 (Analytic Mechanics). The PRESIDENT and Professor FISHER.

F. CHEMISTRY.

Professor Koenig and Messrs. Works and Goettsch.

F 1. General Experimental Chemistry.

Twelve hours a week, twenty-eight weeks. To count as eleven-tenths of a credit. Professor KOENIG, Messrs. .... and WILSON.

F 2. Blowpipe Analysis.

Twelve hours a week, five weeks. To count as two-tenths of a credit. To be preceded by F 1 (General Experimental Chemistry). Professor KOENIG and Mr. GOETTSCH.

F 3. Qualitative Analysis.

Twelve hours a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by F 1 (General Experimental Chemistry) and F 2 (Blowpipe Analysis). Professor KOENIG and Mr. GOETTSCH.

F 4. Volumetric Analysis.

Twelve hours a week, twelve weeks. To count as five-tenths of a credit. To be preceded by F 3 (Qualitative Analysis). Professor KOENIG, and Mr. WORKS.

F 7. Quantitative Analysis.

Twelve hours a week, twenty-one weeks. To count as nine-tenths of a credit. To be preceded by F 4 (Volumetric Analysis). Professor KOENIG and Mr. WORKS.

F 5. Advanced Quantitative Analysis.

Twelve hours a week, thirty-three weeks. To count as twelve-tenths of a credit. To be preceded by, or accompanied with, F 7 (Quantitative Analysis). Professor KOENIG.

F 6. Synthetic Chemistry.

Eighteen hours a week, thirty-three weeks. To count as two credits. To be preceded by F 7 (Quantitative Analysis), F 5 (Advanced Quantitative Analysis), and W 3 (Mineralogy). *Professor KOENIG.*

G. METALLURGY.

Professor Koenig and Mr. Works.

G 1. Assaying.

One hundred seventy-three hours. To count as seven-tenths of a credit. To be preceded by F 3 (Qualitative Analysis), F 4 (Volumetric Analysis), and W 2 (Mineralogy). Professor KOENIG and Mr. WORKS.

G 2. Metallurgy.

Three times a week, thirty-three weeks. To count as eight-tenths of a credit. To be preceded byF 3 (Qualitative Analysis), and preceded by, or accompanied with, F 7 (Quantitative Analysis), and W 3 (Mineralogy). Professor KOENIG.

G 3. Metallurgical Experimentation.

Nine hours a week, thirty-three weeks. To count as one credit. To be preceded by F 7 (Quantitative Analysis), G 1 (Assaying), G 2 (Metallurgy) and W 2 (Mineralogy). Professor KOENIG.

G 4. Metallurgy and Metallurgical Designing.

Nine hours a week, thirty-three weeks. To count as one credit. To be preceded by F 7 (Quantitative Analysis), G 2 (Metallurgy), Q 6 (Graphical Statics), M 3 (Mechanism and Design), M 5 (Mechanical Engineering I), and W 3 (Mineralogy). Professor KOENIG and Mr. WORKS.

M. MECHANICAL ENGINEERING.

Professor Hood, Messrs. Christensen, Harrold, Arnold and Pearce.

M 2. Shop Practice.

Forty-five hours a week, twelve weeks. To count as two credits. Messrs. CHRISTENSEN and HARROLD.

M 15. Mechanical Drawing.

Fifteen hours a week, twelve weeks. To count as six-tenths of a credit. Mr. CHRISTENSEN, Mr. ARNOLD and Mr. PEARCE.

M 16. Machine Drawing.

Fifteen hours a week, eleven weeks. To count as six-tenths of a credit. To be preceded by M 15 (Mechanical Drawing). Mr. CHRISTENSEN, Mr. ARNOLD and Mr. PEARCE.

M 8. Mechanism and Drawing.

Fifteen hours a week, twelve weeks. To count as six-tenths of a credit. To be preceded by M 1. (Properties of Materials), M 16 (Machine Drawing), and preceded by, or accompanied with, C 2 (Analytic Mechanics). Mr. Christensen.

M 12. Mechanical Engineering III.

Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), and preceded by, or accompanied with, C 2 (Analytic Mechanics), and M 4 (Mechanics of Materials). Professor Hood.

M 13. Mechanical Engineering IV.

Three times a week, ten weeks. To count as three-tenths of a credit. To be preceded by M 12 (Mechanical Engineering III.)., and M 16 (Machine Drawing). Professor Hood.

M 9. Mechanical Engineering Laboratory Practice.

Forty-five hours a week, six weeks. To count as one credit. To be preceded by M 13 (Mechanical Engineering IV). Professor Hood and Mr. ....

N. ELECTRICAL ENGINEERING.

Professor Hood and Mr. ....

N 1. Electrical Engineering I.

Three hours a week, twelve weeks. To count as four-tenths of of a credit. To be preceded by M 11 (Mechanical Engineering II.), M 16 (Machine Drawing) and B 1 and B4 (Physics). Mr. ....

N 2. Electrical Engineering II.

Three hours a week, eleven weeks. To count as four-tenths of a credit. To be preceded by N 1 (Electrical Engineering I), and preceded by, or accompanied with, B 3 (Electrical Measurements). Mr. ....

N 3. Electrical Laboratory Practice.

Forty-five hours a week, six weeks. To count as one credit. To be preceded by N 2 (Electrical Engineering II). Professor Hood and Mr. ....

R. MINING ENGINEERING.

Professor Sperr and Messrs. Tucker, McRobbie, Macleod, Arnold and Pearce.

R 1. Principles of Mining.

Eighteen hours a week, sixteen weeks. To count as one credit. Must be preceded by Y 1 (Principles of Geology). Excursions to the mines, etc. This subject is required of all candidates for the B. S. and E. M. degrees. Professor SPERR and Messrs. MCROBBIE and MACLEOD.

R 2. Mine Surveying and Mining. (Classroom Work).—*Three times a week,* sixteen weeks. To count as five-tenths of a credit. To be preceded by Q 1 (Surveying), R 1 (Principles of Mining). Professor SPERR, Messrs. TUCKER and MACLEOD.

R 3. Mine Surveying and Mining. (Field Work). *Forty five hours a week,* five weeks. To count as one credit. To be preceded by R 2 (Mine Surveying and Mining), except for students who enter for this study alone, who are required to be prepared in Algebra, Geometry, Trigonometry, and in the use of the transit and level. Professor SPERR, Messrs. MCROBBIE, MACLEOD, ARNOLD and PEARCE.

R 4. Mining Engineering.

Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by C 2 (Analytic Mechanics), R 3 (Mine Surveying and Mining), and Q 2 (Hydraulics), and preceded by, or accompanied with, M 4 (Mechanics of Mateials). Professor SPERR.

R 5. Mine Management and Accounts.

Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by R 3 (Mine Surveying and Mining. Professor SPERR and Mr. TUCKER.

R 6. Mine Ventilation.

Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by M 5 (Mechanical Engineering I), and Q 3 (Hydraulics). Professor SPERR.

Y. GEOLOGY.

Professor Seaman, Dr. Wright and ....

Y 1. Principles of Geology.

Five times a week, twelve weeks. To count as six-tenths of a credit. This subject is required of all candidates for B. S. and E. M. degrees. Professor SEAMAN.

Y 2. Statigraphical Geology.

Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by V 2 (Zoology and Palæontology), and preceded by, or accompanied with, W 2 (Mineralogy). Professor SEAMAN and Mr. ....

Y 3. Physical and Chemical Geology.

Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by W 2 (Mineralogy), and preceded by, or accompanied with X 1 (Petrography) and Y 2 (Stratigraphical Geology). Professor SEAMAN and Dr. WRIGHT.

Y 4. Geological Field Work.

Forty-five hours a week, six weeks. To count as one credit. To be preceded by Q 1 (Surveying), and Y 3 (Physical Geology), except for those who enter for this study alone. Professor SEAMAN and Dr. WRIGHT.

Y 5. Economic Geology.

Three times a week, twenty-eight weeks. To count as nine-tenths of a credit. To be preceded by R 1 (Principles of Mining), and Y 4 (Geological Field Work). Professor SEAMAN.

A 2. Plane Trigonometry.

Mr. GRANT and Mr. OSBORNE.

The ratio system is used exclusively, and prominence is given to the solution of trigonometric equations, and the transformation of trigonometric expressions. The fall term's work in A 1 (Algebra) must precede or be taken along with this course. Wells's Plane and Spherical Trigonometry is used as the text book.

Three times a week, twelve weeks, fall term. Counts as four-tenths of a credit.

A 3. Spherical Trigonometry.

Professor FISHER, Messrs. OSBORNE and GRANT.

Under this head is given the solution of Right and Oblique spherical triangles from the same text book as is used in subject A 2 (Plane Trigonometry), together with the application to the simpler problems of Spherical Astronomy, such as the student will need in his surveying.

Six times a week, last five weeks of the spring term. Counts as three-tenths of a credit. Must be preceded by A 2 (Plane Trigonometry..

A 4. Analytic Geometry.

Professor FISHER, Messrs. OSBORNE and GRANT.

The course covers the straight line, conic sections, a few higher plane curves, transformation of co-ordinates, general equation of the second degree, and an introduction to geometry of three dimensions. The object is to familiarize the student with methods rather than with any set of curves. Given partly by lectures and partly from Tanner and Allen's Analytic Geometry.

Four times a week, twenty-one weeks, winter and spring terms. Counts as nine-tenths of a credit. Must be preceded by A 2 (Plane Trigonometry), and preceded by, or accompanied with, *A 1 (Algebra).*

ing on the practical work of the mining engineer, and to treat these in as practical a manner as possible. The instruction is given by the laboratory method. The student goes at once into the laboratory, and there, under the direction of the instructors, experiments for himself. The experiments are mostly quantitative.

So far as possible, mere mechanical following of directions is excluded, and intelligent thinking is made necessary to the accomplishment of the work. Every effort is put forth to have the student clearly develop and fix in his mind the principles of Physics which he will afterward use, and also to lay the foundation for that skill in accurate determination of quantity and care of delicate apparatus which are needed by the practical engineer. Accuracy and order are insisted on from the first. Each student receives individual attention, and, with the exception of a few experiments requiring more than one observer, he does his work independently of all other students.

The work of the laboratory is accompanied by illustrated lectures, and by text-book and recitation work.

The department is equipped with a good assortment of modern apparatus for lecture illustration and individual experiment. Detailed lists of pieces which have been published in previous catalogues are no longer considered necessary.

B 1. General Physics.

The PRESIDENT, Professor FISHER, Messrs. OSBORNE, GRANT, HOHL and FORBES.

An elementary course including Mechanics, Heat and Light. Lecture, recitation, and laboratory work proceed together throughout the course. Text-books are Lock's Mechanics for Beginners, Glazebrook's Heat and Light, and Sabine's Laboratory Manual. The geometrical side of Light is developed mostly in the laboratory, the wave theory in the lecture room with the optical lantern and the arc light.

Twelve hours a week, twenty-one weeks, winter and spring terms. To count as eight-tenths of a credit. Must be preceded by, or accompanied with, A 1 (Algebra), and A 2 (Plane Trigonometry).

Nine hours a week, sixteen weeks in the winter and first five weeks of spring terms. To count as five-tenths of a credit. Must be preceded by C 1 (Analytic Mechanics).

B 5. Light.

The PRESIDENT, Professor FISHER and Mr. OSBORNE.

A more advanced course continuing the work begun in this subject in B 1 (Physics). The course is designed particularly for those students who desire to take up Petrography. It deals chiefly with polarization. The subject is presented by experimental lectures which are followed up with individual experiment. A very complete outfit of projection apparatus made by Newton & Co., London, is in the possession of the department for use in this course.

C. MECHANICS.

The President, Professor Fisher, Messrs. Osborne and Grant.

An attempt is made in Mechanics to develop the essential principles, and to render the student proficient in applying them to practical rather than theoretical problems. To this end a large number of problems are solved which, so far as possible, are selected from machines or structures with which the student is already familiar, or the study of which he is subsequently to take up. The work of the class room is accompanied with experimental work in the laboratory, directed mainly toward giving accurate conception of the quantities dealt with.

and figures, and the thinking faculties become numbed rather than quickened. Experience of years has shown, that even a set of notes will have a similar effect on the student. The best results are obtained when the teacher builds up the science from experiment, by making suggestions leading the student to experiment on similar bodies in his own way. In this course there are no definitions of atoms, molecules and structural formulæ to start with. By means of a proper selection of common bodies, the student not only discovers the qualitative and quantitative relations of matter, the simple and compound bodies, but he produces his very reagents as he goes along, he comes to compare and correlate the phenomena; he finally classifies the phenomena, and works up to the evolution of their laws. It is not claimed that any and all brain organizations will become thinking instruments under this system. But it is claimed that it will greatly stimulate and improve existing faculties.

EQUIPMENT OF THE LABORATORIES.

The *Laboratory for General and Experimental Chemistry* is a room 31 1-2x51 feet, situated in the basement of the northeast wing of the Chemistry building. The room receives light from three of its sides. Five desks provide table and closet space for ninety students. A continuous hood runs around three walls of the room with a total length of 102 feet, enabling forty-five students to make use of the hood at one time. The north wall hood is six feet high and is made fire proof. Here all experiments requiring high temperatures are performed in Wind furnaces, Muffle furnaces and Gas furnaces. The instructor's private room opens into the main laboratory. Another adjoining room contains all the special apparatus, which is accessible to the students through the instructor.

The *Laboratory for Qualitative Analysis* occupies the west wing of the main floor. The room is 40x33 feet. Five desks give working and closet space for sixty-four students, with one sink for four places. A continuous hood runs along three of the walls. This hood is divided into compartments of five feet each, to be occupied by one or two students at a time. Each compartment contains two permanent self-supplying water-baths and two gas stop cocks. Four

A *Museum* occupies the west end of the upper floor. It is a splendidly lighted room 31x34 feet. In it are displayed charts and models, which illustrate chemical and metallurgical processes. These latter are further brought nearer to the students by full collections

The *Supply Clerk's* office and the store rooms are located in the
of the raw materials, the intermediate and the finished products.
basement, but are connected with the main floor by means of a dumb-waiter.

F 1 General Experimental Chemistry.

Professor KOENIG, Messrs. .... and WILSON.

Twelve hours a week, twenty-eight weeks; one recitation, three lectures, and six hours of laboratory work each week; to count as eleven-tenths of a credit.

The instruction in this subject covers the following ground:

First. Experiments with the common metals, their action when heated in air, and when heated in the absence of air; discovery of the composite nature of air; a life sustaining part (ozone); a life destroying part (azote). Specific gravity of azote by direct weight and of ozone by calculation. The increase in weight of metals when heated in air, discovery of ozonites (oxides). Ratio of increase. Burning of sulphur in air, discovery of a gaseous sulphur ozonite possessing an acid taste; change of the name ozone into oxygen. Restoration of the original metals from the ozonites by the action of charcoal; hence the notion of elements or simple bodies. Action of the common metals at a red heat upon steam, the forming of bodies similar to the oxides and of an inflammable gas;

the natural gases. The fats, alcohols, ethers, albumenoid bodies. Discovery of cyanogen and its principal compounds.

(7) The study of bone-ash and discovery of phosphorus-oxides and hydroxides of phosphorus.

(8) The study of borax and quartz; boron and silicon.

(9) Theoretical deductions. Electrolysis. Thermo-chemistry. Structural and stereographic formulæ.

The students are required to take notes during the lectures, and they must keep a detailed account of their own observations and deductions in the laboratory. The term standing is derived from these notes and from the recitations, which are held once a week.

F 2. Blowpipe Analysis.

Professor KOENIG and Mr. GOETTSCH.

Twelve hours a week, five weeks. Two lectures, one recitation and nine hours of laboratory work each week. To count as two-tenths of a credit.

This is a short course in Qualitative Analysis in which preference is given to reactions in the igneous way, so that students may be enabled to take the course in Mineralogy with full benefit.

Brush's tables and Landauer's small treatise are referred to.

To be preceded by subject F I (General Chemistry).

F 3. Qualitative Analysis.

Professor KOENIG and Mr. GOETTSCH.

Twelve hours a week, twenty-eight weeks. Two lectures, one recitation, and nine hours of laboratory work each week. To count as eleven-tenths of a credit.

This course embraces the chemistry of the metals and their technically important salts. In the case of Gold, for instance, the student receives 200 mgrs. of the pure metal, and after having converted it into the prescribed compounds and studied the reactions, he must return the gold as pure metal. As this is time-taking, the course has been extended beyond the usual limit.

their previous work that they possess the required originality of mind and practical sense. To all others it is a waste of time. The students are required to read much chemical literature and to discuss their reading in a seminar to be appointed from time to time. The subjects of experimentation may either originate with the student or may be suggested by the professor.

The student must keep a minute account of all his work, in arranging the apparatus, as well as in the actual experiment, whether the latter be a failure or a success.

G. METALLURGY.

Professor Koenig and Mr. Works.

G 1. Assaying.

Professor Koenig and Mr. Works.

One hundred seventy-three hours as follows: Twenty-three lectures and recitations, once a week, and one hundred fifty hours of laboratory work. Koenig's Notes on Assaying (Mimeographed). To count as seven-tenths of a credit. Must be preceded by subjects F 3 (Qualitative Analysis) and F 4 (Volumetric Analysis).

Assayer's Certificates will be given to those students only who

of copper, silver and gold by electrolysis of the matte, or of the black copper by Ziervogel's process.

(5) The leaching process; sulphate leaching; brine leaching; copper-sodium hyposulphite leaching, potassium cyanide leaching, and other chemical possibilities. Chlorination in the dry way by Stetefeld's furnace; by Bruckner's furnace and its modifications. In the wet way according to Plattner, Mears and Koenig. Amalgamation. Refining of crude bullion; parting of gold and silver.

The metallurgy of zinc and aluminum.

To be preceded by F 3 (Qualitative Analysis) and preceded by, or accompanied with, F 7 (Quantitative Analysis)and W 3 (Mineralogy).

G 3. Metallurgical Experimentation.

Professor Koenig.

Nine hours a week, thirty-three weeks. To count as one credit. There are no lectures in this course; the work is wholly experimental. Students must have completed F 7 (Quantitative Analysis), G 1 (Assaying), G 2 (Metallurgy), and W 3 (Mineralogy).

The student may choose among the following subjects:

(1) Comparative extraction of gold ores by amalgamation, by chlorination, and by the smelting process; that is to say, to prove by experiment, which of the foregoing methods will yield the highest percentage of gold from a given gold ore.

(2) Comparative extraction of silver ores by amalgamation or leaching.

(3) Electrolysis of ores or secondary products either in aqueous or igneous liquefaction.

(4) The influence of small quantities of negative elements upon the physical properties of metals and metallic alloys.

The successful and economical operation of any mine depends so largely upon the judicious selection, proper design, and skillful operation of its power plant and general machinery, that the College offers a course in Mechanical Engineering specially designed to prepare the student to take up such work.

The aim has been to so use those Mechanical Engineering subjects of special prominence in mining work as to give the student thorough training, and to indicate the methods of study and observation to be followed after graduation, should he decide to take up any branch of Mechanical Engineering as his specialty.

Throughout the whole course the attempt is made to present clearly the theory underlying each part of the work, and to fix and illustrate the theory by practical exercises in the shop, laboratory, draughting room or reference to neighboring mine equipments.

Mechanical Engineering Building.

The work shops, mechanical laboratories, electrical engineering laboratories, and a draughting room, are located in the Mechanical Engineering Building, a building especially designed for shop and laboratory purposes. It is fully equipped with lavatories, lockers, and everything necessary for the student's convenience and comfort when at work It is lighted with electricity.

Courses in the following subjects are offered -

M 2. Shop Practice.

Mr. Christensen and Mr. Harbold.

Shop practice is of value in giving intimate knowledge of the properties of materials, of the use of machines for working them, and of the difficulties of attaining accuracy. Judgment in the use and selection of any machinery is best trained in the shop. The skill acquired in the use of machines and tools may be of direct value and is always of indirect value in giving familiarity and sympathy with such work. The course covers nine hours a day, except Saturday, for twelve weeks, summer term, and includes practice in wood and metal work. To count as two credits.

One buffing wheel.
One Power hack saw.
One 2-inch pipe and bolt machine.
One Arbor press.

The assortment of chucks, taps, drills, reamers and general tools is extensive. For practice in pipe fitting a separate bench has been provided; a complete set of pipe tools, and a supply of pipe and fittings up to two inches inclusive are in stock.

The blacksmith shop occupies a room 26x43 and is completely equipped with eight forges and the necessary hand and power tools.

The pattern shop contains ten wood lathes, a pattern maker's lathe to swing five feet, a 33-inch Fay band saw, Beach jig saw, 24-inch Fay hand planer and jointer, 24-inch Pony planer, Colburn universal saw bench, emery wheels and grindstones, gouge grinder, steam glue heaters, an extensive assortment of hand tools and appliances, and the necessary work benches and vises.

Each student, in each shop, has a separate work bench, set of hand tools, and locker, for which he is held responsible. Any damage to tools, or other part of the equipment, beyond wear and tear by legitimate use, is charged to the student accountable for it, and must be paid for.

Each shop has a very complete tool room, in which the check system of accounting for tools is used.

Power for the shops is furnished by an 8x24 Reynolds Corliss engine. Both shops are lighted with electricity, the current being obtained from the school plant, or from the mains of the local Electric Co.

Charges.

Tuition fee for the summer term is $40, and laboratory fee is $10. Further, each student is required to purchase all hand files, a 4-inch scale and to pay for stock used whenever work has been spoiled through neglect to obey the orders of the instructor.

Special Students.

Those who desire to take shop work only, and devote all their time to it, are admitted as special students on the following conditions: No student shall be less than 17 years of age. Students between the age of 17 and 20 must present evidence of having spent at *least two years* in some reputable high school or academy. Persons

boiler and attendant details, being an introduction to the Mechanical Engineering of Power Plants. Text-book, Hutton's "The Mechanical Engineering of Power Plants."

M 11. Mechanical Engineering II.

Professor HOOD.

Fifteen hours a week, first five weeks of spring term. To count as three-tenths of a credit. To be preceded by M 5 (Mechanical Engineering I), The same text-book is completed, some subjects being amplified by lectures.

The very extensive and varied power plant equipments in the immediate neighborhood will be used as illustrative material to familiarize the student with the details introduced into the course. Trips of inspection will be taken and reports made.

Questions raised in these general courses (M 5 and M 11) are specially treated at length in subjects M 9, M 10, M 12, M 13, M 14, M 3 and parts of Q 2 and R 2.

M 12. Mechanical Engineering III.

Professor HOOD.

Three times a week, twelve weeks, fall term. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II) and preceded by, or accompanied with, C 2 (Analytic Mechanics) and M 4 (Mechanics of Materials). Thermodynamics of the steam engine. Analysis of steam engine and boiler tests. A course in the theory of the action of steam and the steam engine. Lectures or a text-book on Thermodynamics, and Kent's Mechanical Engineer's Pocket Book

M 13. Mechanical Engineering IV.

Professor HOOD.

Three times a week, ten weeks, spring term. To count as three-tenths of a credit. To be preceded by M 12 (Mechanical Engineering III). Lectures and reading on subjects as Motors (other than

Engineer's Pocket Book and Catalogues.

M 15. Mechanical Drawing

Messrs. CHRISTENSEN, ARNOLD and PEARCE.

Fifteen hours a week, twelve weeks, fall term. To count as six-tenths of a credit.

The use of drawing instruments, the graphical solution of geometrical problems. Descriptive Geometry. Projections on right and oblique planes, intersections of lines, surfaces and solids, plans, elevations and sections, isometric projection. Anthony's Elements of Mechanical Drawing. Reinhardt's Lettering.

The instruction in the art of drawing is designed to give prominence to such branches of the subject as are of most value to the practicing engineer. It is required that the instruments used shall be of the best and for the convenience of students a suitable grade is offered for sale at the College. Instruments required are:

One 5½-inch compass.
One 3¼-inch bow spacer.
One 3¼-inch bow pencil.
One 3¼-inch bow pen.
One 5-inch ruling pen.
One 30°—60° triangle.
One 45° triangle.
One curve.
One 30-inch Tee square.
Two bottles ink.
Eight thumb tacks.
Three rubbers.
Two pencils.
Twelve pens.
One penholder.
Penwipers.
Chamois.
Cloth board covers.
One file pencil-sharpener.
One 15-inch adjustable curve.
One 12-inch white edged scale.

Equipment.

The power plant contains one Parker Steam Generator of 100 H. P., one 58 H. P. Stirling water-tube boiler, one 40 H. P. steel return tubular boiler, one 8x24 Reynolds Corliss engine, an 8x12 Buckeye engine in dynamo room, a 9x9 N. Y. safety vertical slide valve engine in the ore dressing building, a 5x5 horizontal slide valve engine, and one 50 H. P. Wheeler surface condenser, with Worthington air and circulating pump. Of the minor apparatus there is now in stock one Tabor indicator, and four Crosby indicators with electrical attachment, one Hine and Robertson indicator, one Collins continuous indicator, eight polar planimeters, ten of Greene's standard thermometers for calorimetric work, calorimeters of the following kinds —barrel, continuous, superheating, throttling, and separator; Carpenter Coal Calorimeter and Parr Calorimeter—one 15 H. P. Flather hydraulic dynamometer, arranged for either transmission or absorption, Heath's stop-watch speed counter, Tabor speed-counter, Schaeffer and Budenburg tachometer, pantographs, Hine and Robertson reducing motion, draught gauges, Ashcroft boiler test pump and gauge, gauges for use with water or steam, one gauge tester of the Ashcroft pattern, Ashcroft pyrometer, Bristol recording gauge, one Hancock ejector, a number of working injectors, with cut models of same, Buffalo scales of several patterns, Worthington water meter,

used in lighting and power transmission. The laboratory affords practice with direct, alternating and polyphase currents, incandescent and arc lighting, and motors on constant potential, constant current and polyphase circuits.

The equipment includes two direct current dynamos with four motors. A 33 K. W., 1,000 Volt, alternating current machine. A 15 K. W. three phase generator with three motors. Two arc light machines, one constant current motor, a 60 Cell Storage Battery, all with suitable switch board, instruments, transformers and laboratory measuring instruments.

Forty-five hours a week, second six weeks of summer term. To count as one credit. Must be preceded by N 2.

Q. CIVIL ENGINEERING.

Professor Sperr and Messrs. Tucker, McRobbie and Macleod.

Q 4. Topographical Drawing.

Messrs. TUCKER, MCROBBIE and MACLEOD.

Six hours a week, twelve weeks, fall term. To count as three-tenths of a credit.

This subject precedes the work in Surveying. The instruction is given by lectures and practical work in the Drawing Room on the following:

1. Lettering.
   - a. Mechanical.
   - b. Free-Hand.
2. Plotting.
   - a. By Protraction.
   - b. By Rectangular Co-ordinates.
3. Making Scales, Topographical Signs, and Titles.

Instruments required:

One 5-inch right line pen.

One 5 1-2-inch compass (pivot joint) with hair spring, pen, pencil, points, and extension bar.

One 3¼-inch bow pen.

One 3¼-inch bow pencil.

One 3¼-inch bow dividers.

One 6-inch brass protractor.

One 9-inch 45-degree amber triangle.
One dozen German silver thumb tacks, 3-8 diam.
One bottle Higgins' black drawing ink.
One bottle Higgins' carmine drawing ink.
One rubber pencil eraser.
One ink eraser.
One piece Artist's gum 1-2 x 1-2 x 3 inches.
Three 6H pencils.
One piece chamois skin, about 12 x 8 inches.
One-half pan each, moist colors, as follows: Prussian blue, burnt sienna.
One-half dozen No. 1 Spencerian pens, with holder.
Three mapping pens.
One swivel curve pen.

All instruments must be of first-class quality. Students will not be allowed to work with inferior instruments.

Text-Books:

"A System of Free-hand Lettering," Reinhardt.
"The Theory and Practice of Lettering," Sherman.
"Theory and Practice of Surveying," Johnson.

Q 1. Surveying. (Theory and Practice).

Professor SPERR and Messrs. McROBBIE and MACLEOD.

Fifty hours a week, twelve weeks, summer term. Beginning about the middle of June each year. To count as two and two-tenths credits. To be preceded by subjects A 3 (Spherical Trigonometry) and Q 4 (Topographical Drawing), except that persons who wish to attend this course only, are required to prepare themselves upon the subjects of Plane Trigonometry, Logarithms and Mensuration; and provide themselves with the drawing instruments and materials required for Drawing under the Civil Engineering department. All persons who desire to attend are requested to send in their names early to Professor Sperr, or to the president of the College, in order that proper provision may be made for them.

The object of this course is two-fold: First, to give the regular students more thorough and extended practice in the field than it is

part of the time is spent in the Drawing Room.

Text-Book:

Graphical Analysis of Roof Trusses. Greene.

Q 7. Engineering Design and Construction.

Professor SPEER and Mr. TUCKER.

Twelve hours a week, sixteen weeks, winter and first half of spring term. To count as five-tenths of a credit. To be preceded by subject Q 6 (Graphical Statics), and preceded by, or accompanied with, R 4 (Mining Engineering), and M 4 (Mechanics of Materials).

The work in designing is applied to the head-frames, rock houses, engine and boiler houses, bridges, trestles, etc., of the mining plants considered under subject R 4 (Mining Engineering).

A general outline of the work is as follows:

1. The general requirement of the structure.
2. Drawing the general plans.
3. The materials best adapted to the various purposes.
4. Strength of materials.
5. Methods of construction.
6. Making detailed drawings, bills of material, and estimate of costs.
7. Synopsis of the law of contracts
8. Drawing up specifications.
9. Letting contracts.
10. Superintending the construction.

Q 2. Hydraulics. (The flow of water through orifices, weirs, pipes and other conduits). Mr. TUCKER.

Three times a week, sixteen weeks, winter and first half of spring term. To count as five-tenths of a credit. To be preceded by B 1 (Physics) and R 1 (Principles of Mining).

Text-Book:

Treatise on Hydraulics. Merriman.

R. MINING ENGINEERING.

Professor Sperr and Messrs. Tucker, McRobbie, Macleod, Arnold and Pearce.

Mining engineering as here used, signifies carrying through a mining enterprise. Intelligently conducted mining operations employ the principles of mathematics, physics and mechanics; the sciences of geology, mineralogy, chemistry and metallurgy; and the arts of civil, mechanical and electrical engineering; and demand capacity for organization and business management.

These principles, sciences, etc., are taught by specialists and experts in different departments; and their special application to the business of mining is taught under the head of Mining Engineering.

The leading sub-divisions are Mining, Surveying, Engineering and Management.

R 1. Principles of Mining.

Professor SPERR and Messrs. MCROBBIE and MACLEOD.

Eighteen hours a week for sixteen weeks, winter and first half of spring terms. To count as eight-tenths of a credit. Must be preceded by subject Y 1 (Principles of Geology).

The scheme of giving the instruction is as follows:

I. One or more lectures a week are based upon the following outline:

1. Prospecting: aids, methods, outfit, territory and qualifications.

2. Breaking ground; hand tools, machinery and blasting operations.

3. Supporting excavations: rock pillars, timber, masonry and metallic supports.

4. Conveyance of mineral: haulage by men, animals, locomotives, electric motors, single rope, tail rope, endless rope and endless chain; transport by mills, packs, pipes, launders and boats; hoisting receptacles, ropes, motors, signals and safety appliances; pumping oils, mineral solutions and alluvia. Lowering timber and lowering and raising workmen.

5. Drainage: surface—ground water, streams, swamps and lakes; mine—ground water, old workings, and flooded mines.

6. Ventilation: pure air constitutents and requirements; mine air vitiation and purification; accidents from impure air and the means and methods of prevention, rescue and resuscitation.

9. Methods of Traversing Underground.
10. Surveying Coal Mines.
  a. Putting up Sights.
  b. Taking up Rooms, etc.
11. Determination of Strike and Dip.

II. MINING.

1. Coal Mining.
  a. Prospecting the Property.
  b. Locating the Shaft, Slope or Drift.
  c. Laying out the Mine.
2. Iron Ore Mining.
  a. Prospecting the Deposit.
  b. Locating the Shaft.
  c. Laying out the Mine.
    1. Room and Pillar.
    2. Top Slicing.
    3. Sub-Stoping.
3. Mine Timbering
  a. Drifts and Levels.
  b. Stopes.
  c. Rises and Chutes.

The instruction is given from private notes and from references to professional papers to be found in the College library.

R 3. Mine Surveying and Mining. (Field Work).

Professor Sperr and Messrs. McRobbie, Macleod, Arnold and Pearce.

Forty-five hours a week, five weeks, last half of spring term. To count as one credit.

Must be preceded by subject R 2 (Mine Surveying and Mining), except for students who enter for this subject only, who are required to be prepared in Algebra, Trigonometry, and in the use of the transit and level.

The first two weeks are devoted to surveying and mapping a mine or some portion thereof, either in the "Copper Country" or in some one of the iron mining districts of Northern Michigan. The last three weeks are devoted to the examination of mining methods

The proper forms of accounts are designed, ruled up, and the transactions entered thereon. Then the books are closed and the trial balance, production, labor, and cost statements are made out.

R 6. Mechanical Ventilation of Mines.

Professor SPERR.

Two hours a week in lecture room and seven hours in laboratory, sixteen weeks, winter and first half of spring terms. To count as five-tenths of a credit.

The laboratory affords facilities for experimental work with mechanical and hot air ventilators, and with various other means for the production of air currents in mines. The ventilating system of the building was put in with this object in view, and it makes a valuable addition to the equipment. A wide field for investigation and research in the laws of ventilation is here presented for advanced students.

The subject is required to be preceded by, or accompanied with, Q 3 (Hydraulics), R 4 (Mining Engineering) and preceded by M 5 (Mechanical Engineering I).

S. ORE DRESSING.

Mr. TUCKER.

Forty-five hours a week, six weeks. Summer term. To count as one credit.

To be preceded by G 1 (Assaying), Q 2 (Hydraulics), and W 3 (Mineralogy).

Most of the time is given to practical work in the stamp mill, taking a certain time each day for instruction in the theoretical principles involved in the concentration and reduction of gold, silver, copper, lead, iron, and other ores.

The students do all the work in the mill, and each student is given an opportunity to become familiar with all the different kinds of work.

The students are required to take samples and ascertain by fire or wet assay the degree of efficiency of the dressing operations which they are conducting.

Each student is required to spend some time each day in reading

are arranged unlabeled in drawers, and pains will be taken to train the eye to recognize resemblances and differences. Each student is assigned drawers in the working collection, upon which he is required to make individual recitations. In these recitations he must be able to point out the generic characters of the fossils, after having assigned them to their proper class and order . In well preserved specimens he is expected to recognize some of the more important species. Besides the working collection there is a small type collection, of living and fossil forms, arranged zoologically in accordance with Nicholson's New Manual of Palæontology, and a larger one of fossils containing more than three thousand specimens arranged both zoologically, and according to geological horizons. There is also a reference collection of 1,500 invertebrate fossils.

W. MINERALOGY.

W 1. Crystallography.

Professor SEAMAN, Dr. WRIGHT and Messrs. ....

Fall term, *nine hours a week,* twelve weeks. To count as four-tenths of a credit. The instruction is given by means of lecture notes, Elements of Crystallography, G. H. Williams, and laboratory practice in determining the crystal forms on wooden models and natural crystals. Each student recites individually to an instructor.

As the student's future work in mineralogy depends largely upon his knowledge of this subject, he is required to familiarize himself with the principles which it involves.

The law of symmetry is explained somewhat in detail, thus enabling the student to comprehend the derivation of hemihedral and tetartohedral forms, as well as to better understand those forms that are holohedral. Crystal aggregates are briefly considered, and the more common laws of twinning are explained and illustrated with models and natural crystals.

Cleavage is shown to conform to the law of symmetry, and the student is drilled in determining the crystal system, and symmetry of cleavage fragments.

The laboratory is provided with working collections as follows:

For purposes of instruction in W 2 and W 3, the laboratory is supplied with the following collections:

Natural Crystals		3,000	
Natural Crystals, special collection		500	
Collections illustrating Physical Properties, Pseudomorphs, Optical Properties, etc.		485	
Lecture Collection of Minerals		10,000	
Practice Collection of Minerals.			
First Series	2,500		
Second Series	2,100		
Third Series	1,275		
Fourth Series	3,225		
Fifth Series	1,525		
Sixth Series	1,850		
Seventh Series	1,425		
Review Series	3,125		
		17,025	
			31,010

X. PETROGRAPHY.

Dr. Wright.

X 1. Petrography: Lithology and Petrology.

Fall, winter, and half of the spring term, *twelve hours a week*, twenty-eight weeks. To count as eleven-tenths of a credit.

The work is divided into three parts: *Microscopic Mineralogy*, *Lithology* and *Petrology*.

A. *Microscopic* (*Optical*) *Mineralogy:* Under this head are treated the various optical and other characters of minerals as revealed by the microscope. Their alterations are especially studied owing to the importance of these in the subjects of Economic Geology and Lithology.

The lectures given are chiefly devoted to the description and use of the microscope as a simple instrument and as a piece of optical apparatus for the determination of minerals and rocks. This part of the work will comprise the use of the petrographical microscope in common and polarized light, both as a microscope and as

One Fuess's largest petrographical microscope, of the latest pattern, with all the accessories; made expressly for this institution.

One Nachet's largest petrographical microscope, with all the accessories.

One Dick's petrographical microscope, with Swift's objectives and other accessories.

One projection microscope.

One Nachet's inverted chemical microscope.

One Spectroscope.

One spectropolarizer.

One Sorby's apparatus for observing the four images given by biaxial bodies.

Two Calderon's oculars.

Three Bertrand oculars.

One spectroscope ocular.

One goniometer ocular.

One Babinet's compensator ocular.

One Michel-Levy's comparateur.

One axial angle apparatus for measurements in oil.

One periscope eye-piece.

One Filar micrometer.

One cross-hair micrometer.

Three micrometers.

Four camera lucidas.

Two Abbe's camera lucidas.

One Bausch & Lomb's one-inch microphotographic objective.

One mica plate—nose piece.

Many extra eye-pieces, objectives, etc.

One condenser.

One condenser with iris diaphragm.

One Jannettaz's thermal apparatus.

One Latterman's apparatus.

One Fuess's polariscope with accessories.

One new Bausch & Lomb's drawing board for microscope.

One new Goldschmidt's two circle goniometer with accessories, (Model, 1900).

One Groth's universal apparatus, with goniometer.

One Fuess's application goniometer for dull crystals.

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scopic characters of the rock he is studying. The thin sections of rocks for the most part have been made at the College from the hand specimens in the Lecture Collection of Rocks. All practical students of Petrography will recognize the great advantage of this arrangement.

C. *Petrology:* Under this subdivision of Petrography, the various questions relating to the origin, modes of occurrence, relations and alterations of rocks, as observed in the field, are considered. but since the chief portion of the students electing Petrography also elect Physical and Chemical Geology, the majority of the instruction in Petrology is given in connection with that subject.

The entire subject of Petrography is to be taken as a whole, and the student is required to have passed in B 1 (Physics), F 1 (General Chemistry), and W 2 (Mineralogy). W 3 (Mineralogy) and B 5 (Light) must precede or accompany this subject.

In the above course in Petrography the following collections are used:

I. THIN SECTIONS OF MINERALS AND ROCKS.

Sections of Minerals	2,500
Polariscope Sections	132
Sections of Lecture Rock Collection	2,870
Sections of Michigan Rocks	1,000
Sections of Rosenbusch Rock Collection	983
Sections of Other Foreign Rocks	120
Miscellaneous Sections	354
Sections of Stratigraphical Rock Collection	210
Sections of Duplicates of Michigan Geological Survey Collection	260
Sections of Rocks Illustrating L. S. Monographs.	86
Sections of U. S. Educational Series	60
Sections of Private Collection of A. E. Seaman	150
Sections of Norwegian rocks	42
Sections of Saxonian rocks	75
Sections of Arkansas and Wyoming rocks	35
	8,877

Polished Serpentine 80
Polished Ornamental Stones, other than the above 50
Building Stone, including granite, sandstone, limestone, slate, etc. 100

This course must be preceded by W 3 (Mineralogy), X 1 (Petrography), and Y 4 (Field Geology).

J. THESIS.

The Faculty.

J 1. Thesis.

Properly qualified students may include the preparation of a thesis in their work for a degree.

The subject of such thesis must be announced with the schedule of studies for the year in which the degree is expected; further, the elective schedule must be approved by the head of the department in which the thesis work is to be done. This approval will include the subject chosen and the student's preparation to do the work.

The schedule and subject are then considered by the Faculty, whose approval is necessary.

The thesis must be completed by July 1, and submitted to the Faculty for examination and acceptance. For its acceptance it must be accompanied with a written approval of the instructors under whom the work was done.

profession will depend quite as much upon his character and ability as upon his technical training, whether gained in college or out of it. When through his college course, he will, if his work has been properly done, be ready to begin his career in mining.

The location of this institution and its methods of instruction fit its graduates to be useful to their employers in some capacity at the start, and so far they have upon graduation experienced no difficulty in obtaining positions which give them a chance to show forth the material of which they are made. Subsequent advancement depends upon the character and the ability of the individual. His industry and the faithfulness with which he devotes himself to the interests of his employer are two most important factors.

In conclusion it may be said that only those who are willing to do hard and continuous work, both during their course at college and in the years following, should undertake to train for a career in mining. For those who are, and who have an aptitude for engineering pursuits, the outlook is promising.

over 3,000 pamphlets, classified and accessible for reference, and a large number of maps.

The Library is open daily throughout the year, Sundays and legal holidays excepted. While it is intended primarily as an aid to college work, the College authorities are pleased to extend its privileges to such part of the general public as may wish to use it. Mining engineers, and those interested in scientific or technical pursuits, will find it a valuable aid in their research. The library now receives 237 technical and scientific periodicals, etc., which are issued upon application for use in the reading room which adjoins the library.

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available in Science Hall. There follows a list of the principal rooms in this building as they will be occupied after the change.

BASEMENT.

Student's Room	15x33 feet
Gymnasium	31x34 feet
Constant Temperature and Dark Room	14x19 feet
Electrical Laboratory	31x42 feet
Physical Laboratory	32x41 feet

FIRST FLOOR.

Laboratory of Economic Geology	22x27 feet
Palæontological Laboratory	21x27 feet
Geological Laboratory	21x27 feet
Mineralogical Laboratory	27x40 feet
Petrographical Laboratory	24x23 feet
Goniometer Room	7x16 feet
Petrographic Grinding Room	13x16 feet

SECOND FLOOR.

Library	29x49 feet
Office of Librarian and Secretary	14x21 feet
General Executive Office	15x26 feet
President's Room	14x21 feet
Reading Room	28x32 feet
Physical Lecture Room	33x41 feet

THIRD FLOOR.

Mathematical Lecture Room	43x32 feet
Recitation Room	15x26 feet
Geology and Mineralogy Museum	43x49 feet
Recitation Room	24x33 feet

The Mechanical Engineering Building, of brick and stone, is of the extreme dimensions 101x64 feet. It contains the rooms used by the department of Mechanical and Electrical Engineering. The Mechanical Drawing Room on the second floor of this building is an exceptionally well lighted room and well adapted for its purpose. A list of the principal rooms with sizes follows:

building 28 by 28 feet. This furnace is operated in connection with the Ore-Dressing mill.

The Legislature of 1901, in addition to the wing to the Mechanical Engineering Building for blacksmith shop mentioned above, provided for two new buildings, one for the department of Civil and Mining Engineering, the other to accommodate the department of Chemistry.

The Mining Engineering Building is 134 by 53 feet, three stories in height, and is built of brick and stone. In the center of the building there is a tower which carries a large steel tank at the top, thus providing a water supply for the Hydraulic Laboratory which is located in this building. Plans of the various floors are herewith shown.

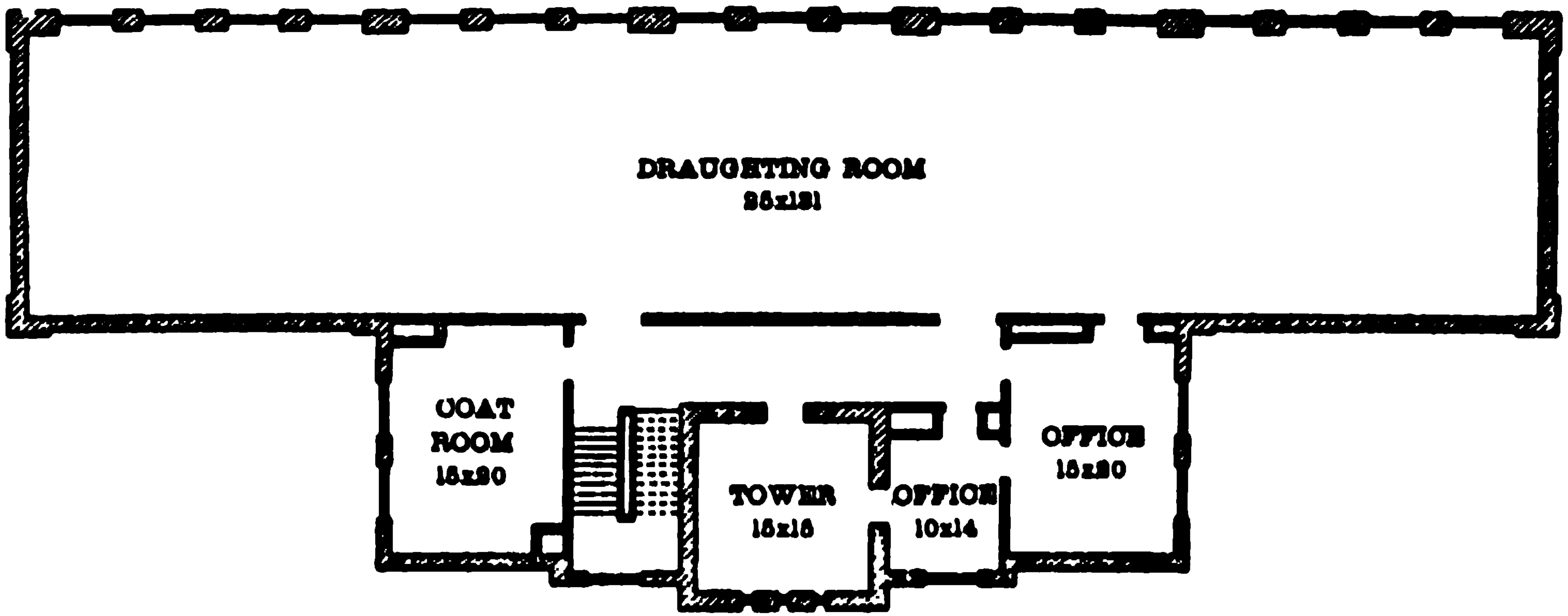
The Chemical Building is 115 by 45 feet, with wings 36 by 17 feet and 53 by 36 feet in size. It is also a brick and stone structure of three stories in height. Its floor plans are shown.

Both of the new buildings are equipped with modern forced ventilation and the ventilating plant in the Mining Engineering Building is arranged to serve illustrative purposes in the teaching of mine ventilation.

The hoods in the Chemical Building have a ventilating system of their own in addition to the general one for the building, thus ensuring the greatest freedom from chemical fumes in the laboratories and offices.

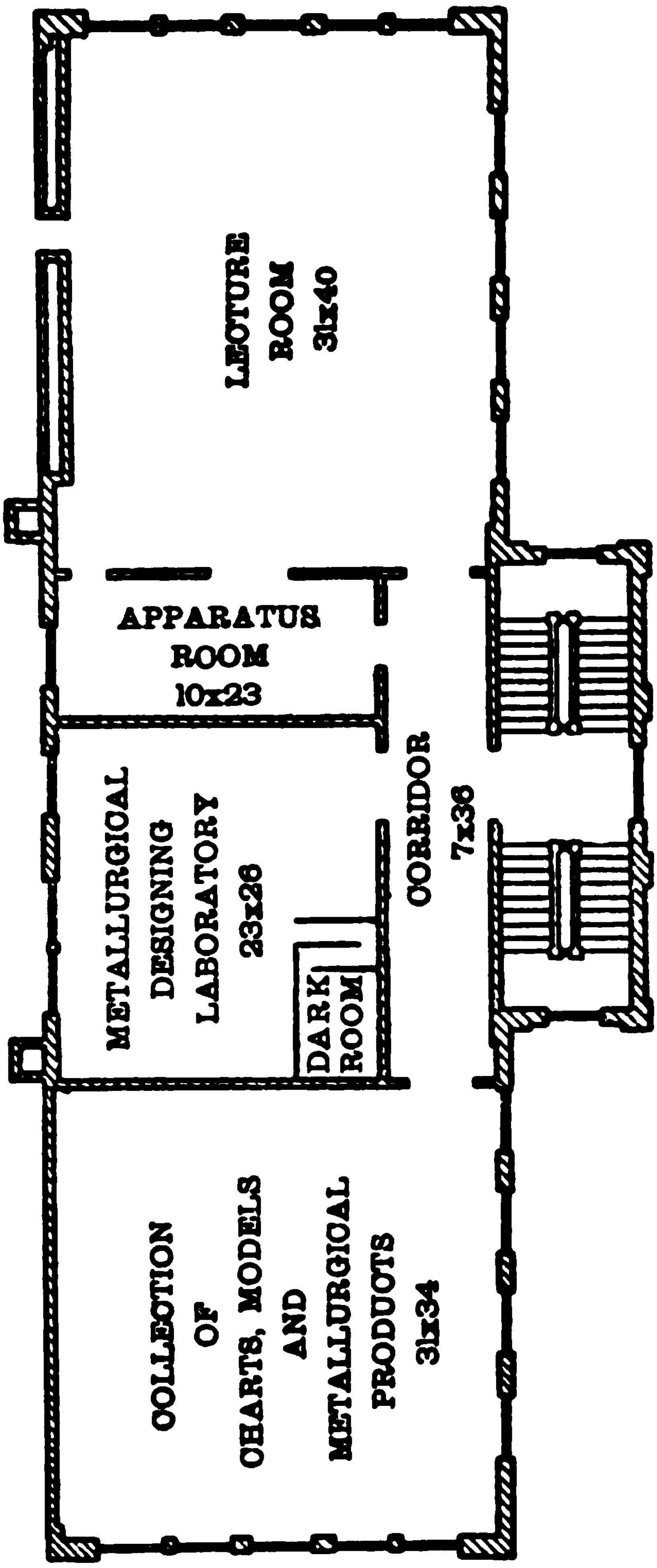
These buildings have been carefully designed and it is believed they embody all of the desirable conveniences and improvements. Their laboratories and lecture rooms will be ready for use at the opening of the year 1902-1903.

MINING ENGINEERING BUILDING



FIRST FLOOR PLAN

CHEMICAL BUILDING



SECOND FLOOR PLAN

been estimated that an average of $425.00 per year will cover the expenses of a Michigan student who lives in moderate comfort, this amount including the cost of tuition, and laboratory fees, board and room, heat, light and books, while $500.00 per year provides amply for the same expenses. The expenses are greater the first year than any following year owing to the necessity of buying books and drawing instruments which are used during the subsequent years. The expenses of course vary much with the taste and habits of the student.

properly occupy his time, he may be required to take additional subjects. If a student has elected more work than he can properly perform he may be required to drop some subjects.

Each instructor is the sole judge of the fitness of every student electing his subjects. He may refuse to admit into his class any student found deficient in preparation, or dismiss him from his courses at any time when his conduct or work is unsatisfactory.

Absences.—All absences bring a daily rank of zero, until the work missed is made up.

A student absenting himself without excuse from more than ten per cent. of the work of any course in any term thereby dismisses himself from the College. In case of field or laboratory courses, the limit is five per cent. instead of ten per cent.

Passing Grade.—A student must obtain a grade of 75 on the scale of 100 to obtain credit for any course. In case of failure to pass or complete a subject, the work can be made up only when this subject is being regularly given.

Failure.—A student who fails in three subjects or who receives conditions in three subjects in any year's work is thereby suspended from the College.

Laboratories.—The laboratories close Friday evening, the closing day of each term, and re-open on Monday morning after the recesses.

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Text Books

A. MATHEMATICS.

A 1. College Algebra. G. A. Wentworth. Ginn & Co., Boston.

A 2 and 3. Plane and Spherical Trigonometry. W. Wells. Heath & Co., Boston.

A 4. Analytic Geometry. Tanner and Allen. American Book Co., New York.

A 5. Manuscript Notes on Calculus. F. W. McNair.

A 5. Elements of the Calculus. J. M. Taylor. Ginn & Co., Boston.

A 6. A Treatise on Ordinary and Partial Differential Equations. W. W. Johnson. John Wiley & Sons, New York.

B. PHYSICS.

B 1 and 4. Manuscript Notes in Physics. F. W. McNair.

B 1 and 4. Laboratory Course in Physics. Last Edition. W. C. Sabine. Ginn & Co., Boston.

B 1 and 4. Heat and Light. R. T. Glazebrook. The Macmillan Co., New York.

B 1. Mechanics for Beginners. J. B. Lock. The Macmillian Co., New York.

B 2 and 3. A Laboratory Manual of Physics and Applied Electricity. E. L. Nichols. The Macmillan Co., New York.

B 2. Lessons on Elementary Practical Physics. Vols. I and II. Balfour Stewart and W. W. Haldane Gee. The Macmillan Co., New York.

B 3. Electrical Measurements. H. S. Carhart and G. W. Patterson, Jr. Allyn & Bacon, Boston.

C. MECHANICS.

C 1 and 2. Mechanics of Engineering. L. P. Church. John Wiley & Sons, New York.

[redacted]

V. BIOLOGY.

V 2. Comparative Zoology. 1895. James Orton. Harper & Bros., New York.

V 2. A Text-Book of Palaeontology. 1900. Karl Von Zittel. Translated by Charles R. Eastman. The Macmillan Co., New York.

W. MINERALOGY.

W 1. Elements of Crystallography. Last Edition. G. H. Williams. H. Holt & Co., New York.

W 2. The System of Mineralogy. Sixth Edition. 1892. James D. Dana and E. S. Dana. John Wiley & Sons, New York.

W 2. Practical Determination of Minerals—Manuscript. 1876-1892. M. E. Wadsworth.

X. PETROGRAPHY.

X 1. Introduction of Optical and Microscopic Mineralogy—Manuscript. 1877-1893. M. E. Wadsworth.

X 1. Microscopical Physiography of the Rock Making Minerals. Third Edition. 1893. H. Rosenbuch. Translated by J. P. Iddings. John Wiley & Sons, New York.

[redacted]

Alexander Patrick Campbell,	*Detroit.*
John Joseph Caulfield, Jr.,	*Grand Rapids.*
Harry Luther Chamberlin, B. S. (Michigan Agricultural College).	*Lansing.*
William Edward Chope	*Detroit.*
Ned J. Churchill,	*Waupaca, Wis.*
Fred LeRoy Clemens,	*Corning.*
Edwin James Collins,	*Calumet.*
Henry Alonzo Coon,	*Rockford.*
Charles Stanhope Cotton, Jr.,	*Detroit.*
William Henry Crago,	*Iron Mountain.*
Gerard Allen Crane, B. A. (Cambridge University, Eng.),	*London, Eng.*
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Edwin Oliver Dane.	*Milwaukee, Wis.*
Robert Cornell Davis,	*Springfield, Ill.*
Henry Edward Devine,	*Ishpeming.*
Samuel Kent Dickinson,	*West Superior, Wis.*
Charles Warren Dodge, Jr.,	*Milwaukee, Wis.*
Dennis Gregory Donahoe,	*Ishpeming.*
Frank Timothy Donahoe,	*Ishpeming.*
Edward Fenner Douglass,	*Houghton.*
Carl Bennet Dunster,	*Bad Axe.*
George Leitch Emrey,	*Manistee.*
Harry Myer Ephraim,	*Flint.*
George Wellington Farrell,	*Bostwick.*
William Nelson Fink,	*Milwaukee, Wis.*
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Clement Albert Foster,	*Rockford.*
Louis Erwin Foster,	*Saginaw.*
John Hubert Gallagher, B. S. (Oregon Agricultural College),	*North Yam Hill, Ore.*
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Burdette F. Grant,	*Albion.*
Theodore Grosse,	*So. Lake Linden.*
Orland Haagsma	*Evanston, Ill.*

Edward James Leach,	*Hancock.*
George Meeker Lewis,	*Chicago, Ill.*
Harold William Light,	*Calumet.*
Carl Brown Lockhart,	*Chicago, Ill.*
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Harold Moore McLaughlin,	*Houghton.*
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Alexander McRobbie,	*Detroit.*
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Henry West Maxwell,	*Chicago, Ill.*
James Harvey Millard,	*Malcolm.*
Richard Whittier Montgomery,	*Saginaw.*
George Charles Moore,	*Dunlap, Iowa.*
James Henry Moore,	*Dunlap, Iowa.*
George Adelbert Morrison,	*Coldwater.*
Allen Vastine Moyer,	*Chicago, Ill.*
Charles James Neal,	*Port Huron.*
James Thomas Norton,	*Houghton.*
Robert Sheldon Oliver,	*Escanaba.*
Frederick Shrewsbury Parkhurst, Jr.,	*LeRoy, N. Y.*
William Pascoe,	*Republic.*
Byron Martin Pattison,	*Superior, Wis.*
Harry A. Pearce,	*Negaunee.*
Louis Chester Pearce, B. S., E. M. (Michigan College of Mines),	*Lake Linden.*
William Charles Pearce,	*Hancock.*
Charles Lawrence Poindexter,	*Los Angeles, Cal.*
Samuel Powell, Jr.,	*Chicago, Ill.*
Frank Bullock Prescott,	*Menominee.*
Victor Rakowsky,	*Duluth, Minn.*

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John Prydderch Williams, Jr.,	*Detroit.*
Percival Sherman Williams,	*Ironwood.*
Clarence Pomeroy Wilson,	*Helena, Mont.*
Frank Brown Wilson,	*Stamford, Conn.*
Job Henry Winwood,	*Houghton.*
Alexander Gordon Wood,	*West Superior, Wis.*
Richard Hoe Worcester,	*Detroit.*
Charles William Wright,	*Ann Arbor.*
Howard Gregory Wright	*Hancock.*
Thomas Kemlo Wright,	*Detroit.*
Edwin Fisk Yates,	*Chicago, Ill.*
Lewis Emanuel Young, B. S. (Pennsvlvania State College),	*Ames, Iowa.*

Summary of Enrollment During Existence of the College

The number of new students who entered, the total enrollment, and the number of graduates sent out for each year of the existence of the College, are as follows :

Electrical Measurements, 62, 75-76.
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Officers of the College, 17-19.
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Quantitative Analysis, 63, 83.
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Volumetric Analysis, 63, 83.

Wright Scholarship, 149-150.

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Table II. Time Schedule. Fall term, 1903.

Table III. Time Schedule . Winter Term, 1904.

Table IV. Time Schedule. First Five Weeks of Spring Term, 1904.

Table V. Time Schedule. Last five Weeks of Spring Term, 1904.

Calendar, 1903-1904

FALL TERM begins Friday morning, September 25, 1903, and ends Friday noon, December 18, 1903—twelve weeks.

Examinations for admission and advanced standing begin Friday morning at 9 o'clock and continue through Friday and Saturday.

Regular work for all classes begins Monday, September 28, 1903, at 8 a. m. Full work is to be taken up at this time.

WINTER TERM begins Monday morning, January 4, and ends Friday noon, March 18, 1904—eleven weeks.

SPRING TERM begins Monday morning, March 28, and ends Saturday evening, June 4, 1904—ten weeks.

SUMMER TERM begins Monday morning, June 6, 1904, and ends Friday evening, August 26, 1904—twelve weeks.

Practical work in Mine Surveying and Mining begins Monday morning, May 2, and ends Friday evening, June 3, 1904.

Surveying begins Monday morning, June 6, and ends Thursday evening, August 25, 1904.

Shop Practice begins Monday morning, June 6, and ends Thursday evening, August 25, 1904.

Ore Dressing and Mechanical Laboratory Practice begin Monday morning, June 6, and end Friday evening, July 15, 1904.

Field Geology, Electrical Engineering Laboratory and Testing Materials of Engineering begin Monday morning, July 18, and end Thursday evening, August 25, 1904.

Michigan College of Mines

GENERAL STATEMENT

The Michigan College of Mines was established by an Act of the Legislature of 1885. The Act was entitled: "An Act to establish and regulate a Mining School in the Upper Peninsula." The Act vested the government of the institution in a Board of Control of six members appointed by the Governor of the State. Two members of the Board are appointed each alternate year to serve six years.

Sec. 5 provides that: "The course of instruction shall embrace geology, mineralogy, chemistry, mining, and mining engineering, and such other branches of practical and theoretical knowledge as will, in the opinion of the board, conduce to the end of enabling the students of said institution to obtain a full knowledge of the science, art and practice of mining, and the application of machinery thereto."

The school was opened for the reception of students September 15, 1886, Its establishment and the earlier appropriations for it are to a very large extent due to the great interest, the foresight and the energy displayed on its behalf by the late Jay A. Hubbell, of Houghton. He donated a large portion of the site occupied by the College, and during his life spared no effort to further its aims or to help it toward prosperity.

It will be seen that the institution is closing its 17th year, yet it can point to successful graduates in almost every mining district of North America. Most of its students have been from Michigan, since it is a Michigan institution, yet it has trained men from all parts of the United States, and from a number of foreign countries in both hemispheres.

The concentration of effort on the training of Mining Engineers, the location of the College in a district where its students live in a mining atmosphere, together with its special methods of instruction

solve the problems presented to it, and to build up an efficient system of training mining engineers. Up to the present time they have stood the test of use very satisfactorily.

ALEXANDER McROBBIE, B.S. (Michigan College of Mines),
Assistant in Civil and Mining Engineering.

THOMAS LEBRETON MACLEOD, B.S. (Michigan College of Mines),
Assistant in Physics and Mining Engineering.

CARROLL RALPH FORBES, B.S. (Michigan College of Mines),
Assistant in Mechanical Engineering.

FRANK BROWN WILSON,
Assistant in Chemistry.

CLYDE HENRY SHOEMAKER,
Assistant in Civil and Mining Engineering.

FRED ALLEN JORDAN,
Assistant in Physics.

GEORGE WATSON COREY,
Assistant in Mineralogy and Geology.

OTHER EMPLOYEES

HENRY GIBBS,
Purchasing Agent and Supply Clerk

MISS CLARA PENBERTHY,
Stenographer.

HARRY SHARP,
Accountant.

JOSEPH CHARLES HEBERT,
Engineer.

MAXIME MORIN,
Carpenter.

FREDERICK CHARLES STRASSER,
Chief Janitor.

ultimately the genuine test of the character of the preparation given by the high school. If therefore the students accepted from such an accredited school shall be found to be deficient in preparation, the school must expect to be dropped from the list.

In case of any considerable change in the course of study or staff of instructors, the school is expected to notify the College, and if requested, it shall submit further evidence of the character of its work. Students of an accredited school who are not graduates can expect to enter the College by examination only.

The following institutions are now on the accredited list of the College:

Alma Academy, Alma, Mich.
Alma High School.
Alpena High School.
Ann Arbor High School
Atlantic High School.
Baraga High School.
Brown City High School.
Butte Business College, Butte, Mont.
Calumet High School.
Caro High School.
Chicago Manual Training School, Chicago, Ill.
Clio High School.
Cobb and Arms Classical School, Chicago, Ill.
Detroit Central High School.
Detroit Western High School.
Duluth High School, Duluth, Minn.
Edgerton High School, Edgerton, Wis.
Escanaba High School.
Flint High School.
Gladstone High School.
Grand Rapids Central High School.
Grass Lake High School.
Hadley High School.
Hancock High School.
Houghton High School.

Hyde Park High School, Hyde Park, Chicago, Ill.
Ionia High School.
Iron Mountain High School.
Ironwood High School.
Ishpeming High School.
Ithaca High School.
Janesville High School, Janesville, Wis.
Kalamazoo High School.
Kansas City Manual Training High School, Kansas City, Mo.
Lake Linden High School.
L'Anse High School.
Ludington High School.
Manistee High School.
Manistique High School.
Marquette High School.
Menominee High School.
Michigamme High School.
Michigan Military Academy.
Milwaukee Academy, Milwaukee, Wis.
Milwaukee East Side High School, Milwaukee, Wis.
Milwaukee South Side High School, Milwaukee, Wis.
Milwaukee West Side High School, Milwaukee, Wis.
Morgan Park Academy, Morgan Park, Ill.
Negaunee High School.
Northwestern Military Academy, Highland Park, Chicago, Ill.
Norway High School.
Phœnix High School, Phœnix, Ariz.
Port Huron High School.
Racine College, Racine, Wis.
Reed City High School.
Republic High School.
Rockford High School.
Rutger's College Preparatory School, Princeton, N. J.
Saginaw East Side High School.
Saginaw West Side High School.
St. Johns Military Academy, Delafield, Wis.
San Antonio Academy, San Antonio, Tex.
Sault Ste. Marie High School.
Shattuck School for Boys, Faribault, Minn.
South Side Academy, Chicago, Ill.

students who are under nineteen years of age, and only for those over nineteen years of age who can show that they have been employed for at least two years in some position entailing responsibility. The College reserves the right to withdraw this offer at any time that it may deem best.

6. Special Students.

Persons who are not candidates for a degree, and who wish to take special studies, are permitted to do so upon giving satisfactory evidence that they are able to pursue with profit the courses they wish to take. If they subsequently desire to become candidates for a degree they must pass the required entrance examinations.

Since its organization the College has had many students of mature age who came for certain training which they considered necessary for their subsequent work. These have proved themselves excellent workers, and the College desires to extend to such persons every possible aid. It has assisted in this way numerous practical and active business men who have had years of previous experience, and it desires to continue a work from which valuable results have been obtained in the past.

Outline List of Courses of Instruction Arranged in Order of Sequence

A. MATHEMATICS.

The President, Professor Fisher, Messrs. Osborne, Grant and Fairbank.

A 1. Algebra.
Three times a week, thirty-three weeks. To count as one credit. Mr. GRANT and Mr. FAIRBANK.

A 2. Plane Trigonometry.
Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by, or accompanied with, A 1 (Algebra). Mr. GRANT and Mr. OSBORNE.

A 3. Spherical Trigonometry.
Six times a week, five weeks. To count as three-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Professor FISHER, Mr. GRANT and Mr. FAIRBANK.

A 4. Analytical Geometry.
Four times a week, twenty-one weeks. To count as nine-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Professor FISHER, Mr. GRANT and Mr. FAIRBANK.

A 5. Differential and Integral Calculus.
Four times a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by A 4 (Analytic Geometry), and B 1 (Physics), and preceded by, or accompanied with, B 4 (Physics). Professor FISHER and Mr. GRANT.

A 6. Introduction to Differential Equations.
Four times a week, five weeks. To count as two-tenths of a credit. To be preceded by A 5 (Calculus). The PRESIDENT.

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B. PHYSICS.

The President, Professor Fisher, Messrs. Osborne, Grant, Fairbank, Macleod and Jordan.

B 1. Physics.
Twelve hours a week, twenty-one weeks. To count as eight-tenths of a credit. Must be preceded by, or accompanied with, A 1 (Algebra) and A 2 (Plane Trigonometry). Professor FISHER, Messrs. OSBORNE, GRANT, FAIRBANK, MACLEOD and JORDAN.

B 4. Physics.
Twelve hours a week, twelve weeks. To count as five-tenths of a credit. Must be preceded by B 1 (Physics). Professor FISHER, Messrs. OSBORNE, GRANT, FAIRBANK and MACLEOD.

B 2. Physical Measurements.
Twenty-four hours a week, five weeks. To count as four-tenths of a credit. Must be preceded by B 1 and B 4 (Physics). The PRESIDENT and Professor FISHER.

B 5. Light.
Six hours a week, twelve weeks. To count as two-tenths of a credit. Must be preceded by B 1 (Physics). The PRESIDENT, Professor FISHER and Mr. GRANT.

B 3. Electrical Measurements.
Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by C 1 (Analytic Mechanics). Mr. OSBORNE.

C. MECHANICS.

Professor Fisher, Messrs. Osborne and Grant.

C 1. Analytic Mechanics.
Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by or accompanied with, A 5 (Calculus). Professor FISHER, Messrs. OSBORNE and GRANT.

M 16. Machine Drawing.
Fifteen hours a week, eleven weeks. To count as six-tenths of a credit. To be preceded by M 15 (Mechanical Drawing). Mr. DeLay and Mr. Forbes.

M 1. Properties of Materials.
Three times a week, twenty-three weeks. To count as seven-tenths of a credit. To be preceded by B 1 (Physics) and F 1 (General Chemistry), and preceded by, or accompanied with B 4 (Physics). Mr. Christensen.

M 5. Mechanical Engineering I.
Three times a week, twelve weeks To count as four-tenths of a credit. To be preceded by M 2 (Shop Practice), M 15 (Mechanical Drawing), and preceded by, or accompanied with, M 1 (Properties of Materials). Professor Hood.

M 11. Mechanical Engineering II.
Fifteen hours a week, five weeks. To count as three-tenths of a credit To be preceded by M 5 (Mechanical Engineering I.). Professor Hood.

M 4. Mechanics of Materials.
Three times a week, twenty-three weeks. To count as seven-tenths of a credit. To be preceded by M 1 (Properties of Materials), and preceded by, or accompanied with, C 2 (Analytic Mechanics). Mr. Christensen.

M 6. Testing Materials of Engineering.
Forty-five hours a week, six weeks. To count as one credit. To be preceded by M 4 (Mechanics of Materials). Professor Hood and Mr. Christensen.

M 10. Pumps and Pumping Machinery.
Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), M 16 (Machine Drawing), and preceded by, or accompanied with, C 2 (Analytic Mechanics). Professor Hood.

M 14. Air Compression and Air Machinery.
Three times a week, ten weeks. To count as three-tenths a credit. To be preceded by M 10 (Pumps and Pumping Machinery). Professor Hood.

M 8. Mechanism and Drawing.

Fifteen hours a week, twelve weeks. To count as six-tenths of a credit. To be preceded by M 1 (Properties of Materials), M 16 (Machine Drawing), and preceded by, or accompanied with, C 2 (Analytic Mechanics). Mr. CHRISTENSEN.

M 12. Mechanical Engineering III.

Three times a week, twelve weeks. To count as four-tenths of a credit. To be proceeded by M 11 (Mechanical Engineering II.), and preceded by or accompanied with, C 2 (Analytic Mechanics), and M 4 (Mechanics of Materials). Professor HOOD.

M 13. Mechanical Engineering IV.

Three times a week, ten weeks. To count as three-tenths of a credit. To be preceded by M 12 (Mechanical Engineering III.), and M 16 (Machine Drawing). Professor HOOD.

M 9. Mechanical Engineering Laboratory Practice.

Forty-five hours a week, six weeks. To count as one credit. To be preceded by M 13 (Mechanical Engineering IV.). Professor HOOD and Mr. CHRISTENSEN.

N. ELECTRICAL ENGINEERING.

Professor Hood and Mr. DeLay.

N 1. Electrical Engineering.

Three hours a week, twenty-three weeks. To count as seven-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), M 16 (Machine Drawing), and B 1 and B 4 (Physics). Mr. DELAY.

N 3. Electrical Laboratory Practice.

Forty-five hours a week, six weeks. To count as one credit. To be preceded by N 2 (Electrical Engineering II.). Professor HOOD and Mr. DELAY.

A 2. [illegible]

Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by, or accompanied with, A 1 (Algebra). Mr. GRANT and Mr. OSBORNE.

A 3. Spherical Trigonometry.

Six times a week, five weeks. To count as three-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Professor FISHER, Mr. GRANT and Mr. FAIRBANK.

A 4. Analytical Geometry.

Four times a week, twenty-one weeks. To count as nine-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Professor FISHER, Mr. GRANT and Mr. FAIRBANK.

A 5. Differential and Integral Calculus.

Four times a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by A 4 (Analytic Geometry), and B 1 (Physics), and preceded by, or accompanied with, B 4 (Physics). Professor FISHER and Mr. GRANT.

A 6. Introduction to Differential Equations.

Four times a week, five weeks. To count as two-tenths of a credit. To be preceded by A 5 (Calculus). The PRESIDENT.

B. PHYSICS.

The President, Professor Fisher, Messrs. Osborne, Grant, Fairbank, Macleod and Jordan.

B 1. Physics.
Twelve hours a week, twenty-one weeks. To count as eight-tenths of a credit. Must be preceded by, or accompanied with, A 1 (Algebra) and A 2 (Plane Trigonometry). Professor FISHER, Messrs. OSBORNE, GRANT, FAIRBANK, MACLEOD and JORDAN.

B 4. Physics.
Twelve hours a week, twelve weeks. To count as five-tenths of a credit. Must be preceded by B 1 (Physics). Professor FISHER, Messrs. OSBORNE, GRANT, FAIRBANK and MACLEOD.

B 2. Physical Measurements.
Twenty-four hours a week, five weeks. To count as four-tenths of a credit. Must be preceded by B 1 and B 4 (Physics). The PRESIDENT and Professor FISHER.

B 5. Light.
Six hours a week, twelve weeks. To count as two-tenths of a credit. Must be preceded by B 1 (Physics). The PRESIDENT, Professor FISHER and Mr. GRANT.

B 3. Electrical Measurements.
Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by C 1 (Analytic Mechanics). Mr. OSBORNE.

C. MECHANICS.

Professor Fisher, Messrs. Osborne and Grant.

C 1. Analytic Mechanics.
Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by or accompanied with, A 5 (Calculus). Professor FISHER, Messrs. OSBORNE and GRANT.

of a credit. Professor SEAMAN, and Messrs. WRIGHT, MOORE and COREY.

W 2. Mineralogy.

Twelve hours a week, sixteen weeks. To count as seven-tenths of a credit. To be preceded by B 1 (Physics), F 1 (General Chemistry), W 1 (Crystallography) and Y 1 (Principles of Geology). Professor SEAMAN, and Messrs. WRIGHT, MOORE and COREY.

W 3. Mineralogy.

Twelve hours a week, twelve weeks. To count as five-tenths of a credit. To be preceded by W 2 (Mineralogy). Professor SEAMAN, and Messrs. WRIGHT, MOORE and COREY.

X. PETROGRAPHY.

Dr. Wright.

X 1. Petrography (Lithology and Petrology).

Twelve hours a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by W 2 (Mineralogy), and preceded by, or accompanied with, B 5 (Light) and W 3 (Mineralogy).

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Y. GEOLOGY.

Professor Seaman, Dr. Wright and Mr. Corey.

Y 1. **Principles of Geology.**
Five times a week, twelve weeks. To count as six-tenths of a credit. This subject is required of all candidates for B. S. and E. M. degrees. Professor SEAMAN and Mr. COREY.

Y 2. **Statigraphical Geology.**
Nine hours a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by V 2 (Zoology and Palæontology), and preceded by, or accompanied with, W 2 (Mineralogy). Professor SEAMAN and Mr. COREY.

Y 3. **Physical and Chemical Geology.**
Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by W 2 (Mineralogy), and preceded by, or accompanied with, X 1 (Petrography) and Y 2 (Stratigraphical Geology). Professor SEAMAN and Dr. WRIGHT.

Y 4. **Geological Field Work.**
Forty-five hours a week, six weeks. To count as one credit. To be preceded by Q 1 (Surveying), and Y 3 (Physical Geology), except for those who enter for this study alone. Professor SEAMAN and Dr. WRIGHT.

Y 5. **Economic Geology.**
Three times a week, twenty-eight weeks. To count as nine-tenths of a credit. To be preceded by R 1 (Principles of Mining), and Y 4 (Geological Field Work). Professor SEAMAN.

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planimeter, receive particular attention.

The Calculus is given by lectures, with printed notes, and Taylor's Differential and Integral Calculus as a text book. *Four times a week,* twenty-eight weeks, fall, winter and spring terms. Counts as eleven-tenths of a credit. Must be preceded by A 4 (Analytic Geometry), and B 1 (Physics), and preceded by, or accompanied with, B 4 (Physics).

A 6. Introduction to Differential Equations.

The PRESIDENT.

An introduction to Differential Equations, which includes the treatment of those special equations which the student will meet in his study of Mechanics and Electricity.

The course is given by lectures and recitations. *Four times a week,* last five weeks of the spring term. Counts as two-tenths of a credit. Open to those who have credit for A 5 (Calculus).

B. PHYSICS.

The President, Professor Fisher, Messrs. Osborne, Grant, Fairbank, Macleod and Jordan.

The aim in the department of Physics, as in that of Mathemat-

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ics, is to select such subjects as have, directly or indirectly, a bearing on the practical work of the mining engineer, and to treat these in as practical a manner as possible. The instruction is given by the laboratory method. The student goes at once into the laboratory, and there, under the direction of the instructors, experiments for himself. The experiments are mostly quantitative.

So far as possible, mere mechanical following of directions is excluded, and intelligent thinking is made necessary to the accomplishment of the work. Every effort is put forth to have the student clearly develop and fix in his mind the principles of Physics which he will afterward use, and also to lay the foundation for that skill in accurate determination of quantity and care of delicate apparatus which are needed by the practical engineer. Accuracy and order are insisted on from the first. Each student receives individual attention, and, with the exception of a few experiments requiring more than one observer, he does his work independently of all other students.

The work of the laboratory is accompanied by illustrated lectures, and by text-book and recitation work.

The department is equipped with a good assortment of modern apparatus for lecture illustration and individual experiment. Detailed lists of pieces which have been published in previous catalogues are no longer considered necessary.

B 1. General Physics.

Professor FISHER, Messrs. OSBORNE, GRANT, FAIRBANK, MACLEOD and JORDAN.

An elementary course including Mechanics, Heat and Light. Lecture, recitation and laboratory work proceed together throughout the course. Text books are Lock's Mechanics for Beginners, Glazebrook's Heat and Light, and Sabine's Laboratory Manual. The geometrical side of Light is developed mostly in the laboratory, the wave theory in the lecture room with the optical lantern and the arc light.

Twelve hours a week, twenty-one weeks, winter and spring terms. To count as eight-tenths of a credit. Must be preceded by, or accompanied with, A 1 (Algebra), and A 2 (Plane Trigonometry).

A 5. Differential and Integral Calculus.

Professor Fisher, Mr. Grant.

The Differential Calculus is developed from a rate as its fundamental notion. The Integral Calculus is from the beginning treated as a method of summation. The object of the course is to give the student a thorough working knowledge of the subject, to put him in possession of a tool of which he can afterward make efficient use. It is believed that this can best be accomplished by giving him a rigorously logical basis for his methods and formulas; and the attempt to do this is therefore made. Applications of differentiation to Expansion in Series, Indeterminate Forms, Maxima and Minima, etc., are treated; while problems of Area, Volume, Work, Pressure, etc., introduce the subject of integration, and their treatment is carried along simultaneously with that of methods. Approximate methods of integration, including the polar planimeter, receive particular attention.

The Calculus is given by lectures, with printed notes, and Taylor's Differential and Integral Calculus as a text book. *Four times a week*, twenty-eight weeks, fall, winter and spring terms. Counts as eleven-tenths of a credit. Must be preceded by A 4 (Analytic Geometry), and B 1 (Physics), and preceded by, or accompanied with, B 4 (Physics).

A 6. Introduction to Differential Equations.

The President.

An introduction to Differential Equations, which includes the treatment of those special equations which the student will meet in his study of Mechanics and Electricity.

The course is given by lectures and recitations. *Four times a week*, last five weeks of the spring term. Counts as two-tenths of a credit. Open to those who have credit for A 5 (Calculus).

B. PHYSICS.

The President, Professor Fisher, Messrs. Osborne, Grant, Fairbank, Macleod and Jordan.

The aim in the department of Physics, as in that of Mathemat-

The text books are Carhart and Patterson's Electrical Measurements, and Nichol's Laboratory Manual.

Nine hours a week, sixteen weeks in the winter and first five weeks of spring terms. To count as five-tenths of a credit. Must be preceded by C 1 (Analytic Mechanics).

B 4. General Physics.

Professor Fisher, Messrs. Osborne, Grant and Fairbank.

Subject B 4 continues the work begun in B 1, and includes Heat and an elementary course in Magnetism and Electricity. Text books used are Glazebrook's Heat and Light, and printed notes on Magnetism and Electricity.

Twelve hours a week, twelve weeks, fall term. To count as five-tenths of a credit. Must be preceded by B 1 (Physics).

B 5. Light.

The President, Professor Fisher and Mr. Grant.

A more advanced course continuing the work begun in this subject in B 1 (Physics). The course is designed particularly for those students who desire to take up Petrography. It deals chiefly with polarization. The subject is presented by experimental lectures which are followed up with individual experiment. A very complete outfit of projection apparatus made by Newton & Co., London, is in the possession of the department for use in this course.

C. MECHANICS.

Professor Fisher, Messrs. Osborne and Grant.

An attempt is made in Mechanics to develop the essential principles, and to render the student proficient in applying them to practical rather than theoretical problems. To this end a large number of problems are solved which, so far as possible, are selected from machines or structures with which the student is already familiar, or the study of which he is subsequently to take up. The work of the class room is accompanied with experimental work in the laboratory, directed mainly toward giving accurate conception of the quantities dealt with.

C 1. Analytic Mechanics.

Professor Fisher, Messrs. Osborne and Grant.

Church's Mechanics of Engineering, Parts I and II, Statics and Dynamics, is made the basis of this and the following course.

Subject C 1 occupies three hours in class room and three in the Laboratory each week for sixteen weeks, in the winter and spring terms. Counts as five-tenths of a credit.

It must be preceded by B 1 (Physics), and preceded by, or accompanied with, A 5 (Calculus).

C 2. Analytic Mechanics.

Professor FISHER and Mr. OSBORNE.

Subject C 2 continues the work begun in C 1, and is given three hours in class room and three in the laboratory each week, twelve weeks, in the fall term. Counts as four-tenths of a credit.

It must be preceded by C 1 (Analytic Mechanics).

F. CHEMISTRY.

Professor Koenig, Messrs. Works, Goettsch, Wilson and Burnham.

The instruction in Chemistry is designed to excite in the student a love for experimentation and to train him to inductive thinking. If this aim can be reached, or if it can only be approximated, it is believed that the gain to the student will be great, much greater than that from the accumulation of any number of facts. All modern advancement in the subjugation of Nature's forces is owing to experiment, and we know from the autobiographical statements of many inventors of genius, that they lost the labor of years through the lack of training in properly correlating the results of their experiments.

In carrying out the plan of this course it has been found necessary and useful to abandon the use of text books altogether. For no matter how a text book be written and arranged it will present to the beginner the science of chemistry as a finished edifice, very wonderful and very intricate in its details. The study of it thus becomes of necessity mechanical; the memory is loaded with facts and figures, and the thinking faculties become numbered rather than quickened. Experience of years has shown, that even a set of notes will have a similar effect on the student. The best results are obtained when the teacher builds up the science from experiment, by making suggestions leading the student to experiment on similar bodies in his own way. In this course there are no definitions of

sodium, calcium, of caustic soda, caustic potash, and of a non life-sustaining heavy, slightly sour gas, lime gas (not CO^2). Alkaline reaction, acid reaction; the notion of hydroxides, of acid hydroxides and of basic hydroxides.

(3) Study of common salt, the mother-liquor salt, and the varec salt; the spirits of salt. Decomposition into a green gas and hydrogen. Chlorine probably a simple body. Bromine, iodine, fluorine. Action of Chlorine upon hydrogen in equal volumes. The theory of combinations by volumes; the notion of *molecules* and *atoms;* of molecular weights and atomic weights. The action of chlorine upon the common metals—the chlorides, their properties. Reproduction of salt by acting with spirits of salt upon soda-ash—hence the identity of the metal in salt and soda-ash. Atomic weight of sodium and potassium by experiment.

(4) The study of nitre Action in heat. Yields a gas which sustains combustion and animal breathing. Identification of this gas with the ozone or oxygen of the air. The notion of super or peroxides. The spirits of nitre. Its action upon the metals. Discovery of nitrogen and identification of this gas with the ozote of the air. The several oxides of nitrogen. Nitrogen chloride Action of zinc and caustic potash upon nitre. Discovery of a gaseous alkaline body: Ammonia. Study of its properties and combinations; ammonium salts

(5) The study of sulphur. The oxides and chlorides of sulphur. The manufacture of hydrogen sulphate.

(6) Discovery of carbon by decomposing the limestone gas with sodium. Identification of this body with the substance of charcoal, of mineral coal, of plant and animal structures. The mineral oils, the natural gases. The fats, alcohols, ethers, albumenoid bodies. Discovery of cyanogen and its principal compounds.

(7) The study of bone-ash and discovery of phosphorus-oxides and hydroxides of phosphorus.

(8) The study of borax and quartz; borum and silicon.

(9) Theoretical deductions. Electrolysis. Thermo-chemistry. Structural and stereographic formulæ.

The students are required to take notes during the lectures, and they must keep a detailed account of their own observations and deductions in the laboratory. The term standing is derived from these notes and from the recitations, which are held once a week.

very carefully prepared, so that the difficulties and losses which are inherent in the methods may be fully understood by the students.

G 2. Metallurgy.

Professor Koenig.

Four times a week, thirty-three weeks, or three lectures and one recitation a week. To count as eight-tenths of a credit.

It is the intention that the student acquire in this course the principles and practice of modern methods in the extraction of the technically useful metals. For those who intend to follow metallurgy as a specialty it is to be the broad foundation upon which to raise their further education. Others will, through it, be enabled to read understandingly the technical advances in the current literature.

The instruction covers the following subjects:

(1) Fuel: Gas versus oils and solid coal; its technical and economical aspects; essential and unessential parts in gas generator; smokeless combustion. Coking. The physical and chemical qualities of pig iron. Relations between the composition of iron ores and the resulting pig iron. The chemistry of the blast furnace. Calculation of cinder or slag compositions. Influence of the profile, cross sections and height of the blast furnace upon the qualities and quantity of the product.

(2) Dry puddling. The Bessemer process. The Thomas-Gilchrist process.

(3) Wet puddling; the common puddling furnace; the rotary puddlers; the open hearth process. Washing out of Phosphorus. Washing out of sulphur by manganese. Crucible steel; cement steel; Mushet steel; chrome steel; phosphor steel. Theory of the tempering process. Malleable cast iron. Ferro-silicon in steel-casting. The Harvey process. Aluminum in melting and casting wrought iron.

(4) The metallurgy of lead, copper, silver, gold. The Muldener-Huette Process. Desilverization of work lead by zinc and aluminum. Cupellation. The refining of copper matte. Separation of copper, silver and gold by electrolysis of the matte, or of the black copper by Ziervogel's process.

(5) The leaching process; sulphate leaching; brine leaching; copper-sodium hyposulphite leaching, potassium cyanide leaching,

cf the required power; arrangement of the machinery as to economy of space and economy of manual labor in the successive operations; estimated cost of the plant.

For the work of this course a room on the upper floor of the Chemistry building has been appropriated. This room has windows with a northern exposure only, and is provided with twelve drawing tables; a photographic outfit for reducing or enlarging original drawings; a dark closet, and a blue-printing frame.

M. MECHANICAL ENGINEERING.

Professor Hood, Messrs. Christensen, Harold, DeLay and Forbes.

The successful and economical operation of any mine depends so largely upon the judicious selection, proper design and skilful operation of the power plant and general machinery, that the College offers a course in mechanical engineering specially designed to prepare the student to take up such work.

The aim has been to so use those Mechanical Engineering subjects of special prominence in mining work as to give the student thorough training, and to indicate the methods of study and observation to be followed after graduation, should he decide to take up any branch of Mechanical Engineering as his specialty.

Throughout the whole course the attempt is made to present

sons 20 years of age or over may be admitted as special students, without having attended a high school, provided they give evidence of being able to follow the work with profit. Some knowledge of drawing, or practice in reading drawings is essential

The course is open to all who a
pursuance of its general policy the
assist, all who are competent and
themselves of its advantages; those
diligently to the work and who sho
of no advantage to themselves, or i
promptly excluded from the course.
will require all the student's time and

Under some conditions the machi
other times than at the summer ter

M 3. Mechanism and Drawing.

Mr. Christ

Fifteen hours a week, twelve we
six-tenths of a credit. To be preced
terials), M 16 (Machine Drawing),
nied with, C 2 (Analytic Mechanics)
means of solving problems arising in
wheels, belting, etc., of the laws of
of wheels, aggregate motion and mis
mechanics. Problems are worked out as they would be in practice over the drawing board. From sketches illustrating an idea or from partial plans of a machine the student is thrown somewhat on his own resources for the design of elements, and more or less detail, according to his ability.

M 4. Mechanics of Materials.

Mr. Christensen.

Three times a week, twenty-three weeks, fall and winter terms. To count as seven-tenths of a credit. To be preceded by M 1 (Properties of Materials), and preceded by, or accompanied with, C 2 (Analytic Mechanics.)

Application of the principles of statics to rigid bodies; elasticity and resistance of materials; cantilevers; simple, restrained and continuous beams; forms of uniform strength, riveting, torsion of

as one credit. Must be preceded by subject M 13 (Mechanical Engineering IV.) This course is intended to give the student ample opportunity to verify practically the principles laid down in the preceding courses. Each student will be required to set up his own apparatus, and in many cases to design and build appliances for any special work on hand.

Equipment.

The power plant contains one Parker Steam Generator of 100 H. P., one 58 H. P. Stirling water-tube boiler, one 40 H. P. steel return tubular boiler, induced draft system, one 8x24 Reynolds Corliss engine, an 8x12 Buckeye engine in the dynamo room, a 9x9 N. Y. safety vertical slide valve engine in the ore dressing building, a 5x5 horizontal slide valve engine, and one 50 H. P. Wheeler surface condenser, with Worthington air and circulating pump. Of the minor apparatus there is now in stock one Tabor indicator, and six Crosby indicators with electrical attachment, one Hine and Robertson indicator, one Collins continuous indicator, eight polar planimeters, ten of Greene's standard thermometers for calorimetric work, calorimeters of the following kinds—barrel, continuous, superheating, throttling, and separator; Carpenter Coal Calorimeter, and Parr Calorimeter — one 15 H. P Flather hydraulic dynamometer arranged for either transmission or ab-

The very extensive and varied power plant equipments in the immediate neighborhood will be used as illustrative material to familiarize the student with the details introduced into the course. Trips of inspection will be taken and reports made.

Questions raised in these general courses (M 5 and M 11) are specially treated at length in subjects M 9, M 10, M 12, M 13, M 14, M 3 and parts of Q 2 and R 2.

M 12. Mechanical Engineering III.

Professor Hood.

Three times a week, twelve weeks, fall term. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.) and preceded by, or accompanied with, C 2 (Analytic Mechanics) and M 4 (Mechanics of Materials). Thermodynamics of the steam engine. Analysis of steam engine and boiler tests. A course in the theory of the action of steam and the steam engine. Lectures or a text book on Thermodynamics, and Kent's Mechanical Engineer's Pocket Book.

M 13. Mechanical Engineering IV.

Professor Hood.

Three times a week, ten weeks, spring term. To count as three-tenths of a credit. To be preceded by M 12 (Mechanical Engineering III.) and M 16 (Machine Drawing). Lectures and reading on subjects: as motors (other than steam), lubrication, the transmission of power, measurement of power, compressors, pumps, hoists, chimneys, heating systems, etc. Kent's Mechanical Engineer's Pocket Book, the library, and neighboring plants.

M 14. Air Compression and Air Machinery.

Professor Hood.

Three times a week, ten weeks, spring term. To count as three-tenths of a credit. To be preceded by M 10 (Pumps and Pumping Machinery). A study of the action of air during compression, expansion, its flow through pipes, and also of the various types of air compressing and actuating machinery. Lectures, Kent's Mechanical Engineer's Pocket Book and Catalogues.

Fifteen hours a week, eleven weeks, winter term. To count as six-tenths of a credit. To be preceded by M 15 (Mechanical Drawing).

Making of complete working drawings of various details of machine construction from drawings, sketches or models. Tracing and blue printing. Anthony's Machine Drawing.

N. ELECTRICAL ENGINEERING.

Professor Hood and Mr. DeLay.

The rapid development of electrical methods as applied to a wide field of mining practice in lighting, power transmission, and metallurgical manipulation, makes a broad knowledge of the principles of electricity necessary to the well-equipped mining engineer. A study of electrical engineering, both fixes these principles and gives some familiarity with current engineering practice. Such subjects as are of special prominence in mining are naturally accentuated here. The courses outlined are as follows:

N 1. Electrical Engineering.

Mr. DeLay.

An introductory course presenting dynamo and motor construction, transformers, secondary batteries, lamps, etc., and questions

manner.

An outline of the work is as follows:

I. Preliminary Surveying.

1. Pacing practice.
2. Preliminary location of mining claims and filing of notice of location.
3. Adjustment of hand level. Short line of levels with the hand level.
4. Topographical survey of mining claim by pacing and hand level.
5. Ranging practice with pickets and chain.

II. Land Surveying.

1. Adjustment of compass.
2. Subdivision of a section of land according to United States Land Office regulations, location of lost corners, etc.
3. Farm survey with compass and chain. Computation of acreage.
4. City survey of portion of Houghton, location of street, alley, and lot lines by transit and steel tape. Platting an addition.
5. Survey of mining claim with solar instrument, official sur-

one from Mahn; five Burt solar compasses; seven needle compasses; fourteen Wye levels, eight from Gurley, three from Heller and Brightly,, one from Buff and Berger, and two from C. L. Berger & Sons; ten water levels; forty-eight Locke hand levels. In addition to these more expensive instruments the College owns the necessary number of chains, steel tapes, poles, rods, etc.

The furnishing of the Surveying apparatus by the College is a heavy expense to the institution, and while losses due to ordinary and legitimate wear and tear of the instruments are borne by the College, any injuries due to carelessness on the part of the student must be made good by him.

Every student is required to provide himself with a steel pocket tape graduated to feet and tenths, and not less than 25 feet long, a pocket compass, a reading lens, a wood ax, a timber pencil, a hard pencil, and note book.

Text-Books:

Theory and Practice of Surveying, Johnson.
Field Engineering, Searle.

Q 2. Hydraulics. (The flow of water through orifices, weirs, pipes and other conduits). Mr. CHAMBERLIN.

Three times a week, sixteen weeks, winter and first half of

spring term. To count as five-tenths of a credit. To be preceded by B 1 (Physics) and R 1 (Principles of Mining).
Text-Book:
Treatise on Hydraulics. Merriman.

Q 3. Hydraulics. (Hydrostatics, Hydrodynamics, and Hydraulic Engineering). Professor SPERR.

Two hours a week in lecture room and seven hours in laboratory, sixteen weeks, winter and first half of spring terms. To count as five-tenths of a credit. To be preceded by A 5 (Calculus), C 2 (Analytic Mechanics) and Q 2 (Hydraulics).
Text-Book:
Treatise on Hydraulics. Merriman.

Q 4. Topographical Drawing.

Messrs. CHAMBERLIN, MCROBBIE and SHOEMAKER.

Six hours a week, twelve weeks, fall term. To count as three-tenths of a credit. The subject is required for the summer course in surveying (Q 1). The course is given by lectures and individual instruction in the Drawing Room on the following:

I. Care and use of drawing instruments.
II. Lettering.
  1. Mechanical.
  2. Freehand.
III. Making Titles, Scales, Borders, etc.
IV. Traversing.
V. Plotting.
  1. By Protraction.
  2. By Rectangular Co-ordinates.
VI. Topography.
  1. Topographical Signs.
  2. Topographical Maps.

Instruments Required:
One 5-inch right line pen.
One swivel curve pen.
One 5½ inch compass (pivot joint) with hair spring, pen, pencil, points and extension bar.
One 3¼-inch bow pen.

One 3¼-inch bow pencil.
One 3¼-inch bow dividers.
One protractor.
One 12-inch triangular decimal scale.
One 10-inch 30 x 60-degree amber triangle.
One 9-inch 45-degree amber triangle.
One-half dozen thumb tacks.
One bottle Higgins' black water-proof drawing ink.
One bottle Higgins' carmine drawing ink.
One rubber pencil eraser.
One ink eraser.
One sponge rubber.
One 6H pencil.
One piece chamois skin, about 12 x 8 inches.
One-half pan each, moist colors, as follows: Prussian blue, burnt sienna.
Two No. 1 Spencerian pens, with holder.
Two mapping pens.
Two ball pointed pens.

All instruments must be of first-class quality. Students will not be allowed to work with inferior instruments. Articles in the above list may be purchased by students at the College.

Text-Books:

A System of Free-hand Lettering, Reinhardt.
The Theory and Practice of Lettering, Sherman.
Theory and Practice of Surveying, Johnson.

Q 5. Topographical Mapping.

Messrs. CHAMBERLAIN, MCROBBIE and SHOEMAKER.

Nine hours a week for twelve weeks, fall term. To count as four-tenths of a credit. To be preceded by Q 1 (Surveying.

This subject follows the work in surveying, and is intended to give the student a more complete course in the construction of a map than can be obtained from Q 4 and Q 1.

The outline of the course is as follows:

1. Care and use of instruments.
2. Collection of data.
3. Adjustment of triangulation system, triangles and quadrilaterals.

spring terms. To count as five-tenths of a credit. To be preceded by Q 1 (Surveying) and R 1 (Principles of Mining).

OUTLINE OF THE SUBJECT.

I. MINE SURVEYING.

1. Definition.
2. Objects and Purposes.
3. Maps Required.
4. Instruments Used.
5. Adjustment of the Transit.
   a. Adjustment of the Side Telescope.
   b. Adjustment of the Top Telescope.
6. The Reference Line.
7. Connection of the surface with the underground survey through an inclined shaft or slope.
   a. Form of Notes.
   b. Problems.
8. Connection of the surface with the underground survey through a vertical shaft.
   a. With the Transit.
   b. By means of Plumb Lines.
9. Methods of Traversing Underground.
10. Surveying Coal Mines.
   a. Putting up Sights.
   b. Taking up Rooms, etc.
11. Determination of Strike and Dip.

II. MINING.

1. Coal Mining.
   a. Prospecting the Property.
   b. Locating the Shaft, Slope or Drift.
   c. Laying out the Mine.
2. Iron Ore Mining.
   a. Prospecting the Deposit.
   b. Locating the Shaft.
   c. Laying out the Mine.
3. Mine Timbering.
   a. Drifts and Levels.
   b. Stopes.
   c. Raises and Chutes.

R 5. Mine Management and Acounts.

Professor SPERR and Mr. CHAMBERLIN.

Nine hours a week, sixteen weeks, winter and first half of spring terms. To count as five-tenths of a credit. To be preceded by R 1 (Principles of Mining) and R 3 (Mine Surveying and Mining).

The subject comprises the following:

1. Employment, organization and discipline of labor.
2. Purchase and use of supplies.
3. Preparation and sale of mineral.
4. Mine accounts, trial balances, and cost and labor statements.

Given by lectures and a set of notes covering the daily transactions for one month of an extensive mining business.

The proper forms of accounts are designed, ruled up, and the transactions entered thereon. Then the books are closed and the trial balance, production, labor and cost statements are made out.

R 6. Mechanical Ventilation of Mines.

Professor SPERR.

Two hours a week in lecture room and seven hours in laboratory, sixteen weeks, winter and first half of spring terms. To count as five-tenths of a credit.

The laboratory affords facilities for experimental work with mechanical and hot air ventilators and with various other means for the production of air currents in mines. The ventilating system of the building was put in with this object in view, and it makes a valuable addition to the equipment. A wide field for investigation and research in the laws of ventilaton is here presented for advanced students.

The subject is required to be preceded by, or accompanied with, Q 3 (Hydraulics), R 4 (Mining Enginering) and preceded by M 5 (Mechanical Engineering I.).

S. ORE DRESSING.

Forty-five hours a week, six weeks, summer term. To count as one credit.

To be preceded by G 1 (Assaying), Q 2 (Hydraulics), and W 3 (Mineralogy).

defined, and the student will be expected to recognize the genera given.

It will be the aim of this course to train the student to close and accurate observation, and special care will be taken to point out those characters by which genera may be recognized and determined. The student will be required to determine about one hundred genera which have been specially selected to cover nearly the entire geological column. There is a working collection of more than four thousand specimens, which will be used to drill the students in determining fossils in various states of preservation. The specimens are arranged unlabeled in drawers, and pains will be taken to train the eye to recognize resemblances and differences. Each student is assigned drawers in the working collection upon which he is required to make individual recitations. In these recitations he must be able to point out the generic characters of the fossils, after having assigned them to their proper class and order. In well preserved specimens he is expected to recognize some of the more important species. Besides the working collection there is a small type collection, of living and fossil forms, arranged zoologically in accordance with Nicholson's New Manual of Palæontology. and a larger one of fossils containing more than three thousand specimens arranged both zoologically, and according to geological horizons. There is also a reference collection of 1,500 invertebrate fossils.

W. MINERALOGY.

W 1. Crystallography.

Professor SEAMAN, Dr. WRIGHT and Messrs. WRIGHT, MOORE and COREY.

Fall term, *nine hours a week,* twelve weeks. To count as four-tenths of a credit. The instruction is given by means of lecture notes, Elements of Crystallography, G. H. Williams, and laboratory practice in determining the crystal forms on wooden models and natural crystals. Each student recites individually to an instructor.

As the student's future work in mineralogy depends largely upon his knowledge of this subject, he is required to familiarize himself with the principles which it involves.

The law of symmetry is explained somewhat in detail thus enabling the student to comprehend the derivation of hemihedral and

minerals are assigned to each student, who is to determine them and to recite upon them, not in a class, but singly with the instructor. In fact, individual work is one of the features of instruction in the Geological Department. Each student is required to do that which the practical mineralogist does; to determine his minerals by the shortest method possible, consistent with accuracy; the method to vary according to the specimen. To this end every method of determination short of quantitative anaylsis is employed; that is in each case the crystal form and other physical characters are used, as well as the blow-pipe and wet tests, so far as they may be needed.

After the student has studied and recited upon the specimens contained in a sufficient number of drawers of one group, he is assigned to drawers containing the unlabeled minerals of another group, which have mixed with them specimens of the preceding group or groups. In this way each student is required to determine in his course from 3,000 to 6,000 different mineral specimens, belonging to two hundred and ninety selected species.

The instruction is based on the sixth edition of Professor James D. Dana's System of Mineralogy, revised by Professor Edward S. Dana, 1892, and every student is expected to provide himself with a copy.

In addition, or supplementary to this work, there is given a series of lectures and notes prepared by Dr. Wadsworth for use in his classes in 1876, and revised and enlarged from time to time since. In these notes the characteristic features of each mineral, its uses, and the practical methods employed to distinguish each one, are pointed out. Especial attention is given to the methods needed in the field and mine, where one cannot have recourse to a chemical laboratory. Every effort is made to train the student to close, accurate observation, to reason correctly upon what he sees, and to exercise good judgment in his decisions.

The result of this work is such that a student not only knows how to proceed, in order to determine any mineral that he may meet, but he is also enabled to recognize at sight, or by simple tests, the great majority of specimens belonging to the two hundred and ninety mineral species that he is required to study in his course. W 2 will cover the first four series as arranged in the working collection.

This subject is to be preceded by B 1 (Physics), F 1 (Chemistry), F 2 (Blowpipe Analysis) and W 1 (Crystallography).

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W 3. Mineralogy.

Professor SEAMAN and Messrs. WRIGHT, MOORE and COREY.

Fall term, *twelve hours a week, twelve weeks.* To count as five-tenths of a credit. This course to be preceded by W 2 (Mineralogy).

The instruction is given the same as in W 2 and the work required consists of a review of W 2, and the completion of the three series as arranged in the working collection, beginning with the hydrous silicates.

For purposes of instruction in W 2 and W 3 ,the laboratory is supplied with the following collections:

Natural Crystals		3,000	
Natural Crystals, special collection		500	
Collections illustrating Physical Properties, Pseudomorphs, Optical Properties, etc		485	
Lecture Collection of Minerals		10,000	
Practice Collection of Minerals:			
First Series	2,500		
Second Series	2,100		
Third Series	1,275		
Fourth Series	3,225		
Fifth Series	1,525		
Sixth Series	1,850		
Seventh Series	1,425		
Review Series	3,125		
		17,025	
			31,010

X. PETROGRAPHY.

Dr. WRIGHT.

X 1. Petrography: Lithology and Petrology.

Fall, winter, and half of the spring term, *twelve hours a week,* twenty-eight weeks. To count as eleven-tenths of a credit.

The work is divided into three parts: *Miscropic Mineralogy, Lithology* and *Petrology.*

A. *Microscopic (Optical) Mineralogy:* Under this head are treated the various optical and other characters of minerals as revealed by the microscope. Their alterations are especially studied

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One Groth's universal apparatus, with goniometer.
One Fuess's application goniometer for dull crystals.
One Fuess's reflection goniometer.
One Hirschwald's microscope gionometer.
One Linholf's reflection goniometer
One total reflectometer attachment.
Fourteen Miller's goniometers.
One Stage goniometer.
One Bertrand's micro-goniometer, with special stage.
One flask for measuring index of fluids.
One pyroelectric duster.
One Streng's chest and apparatus for microchemical reactions.
Kranz set of Dupare's models for the demonstration of the optical properties of crystals.
Three celluloid models illustrating dispersion of axes and bisectrices of monoclinic minerals.

B. *Lithology:* The instruction in this branch of Petrography comprises both the macroscopic and the microscopic study of rocks. For this work large and complete collections of rock specimens, with numerous thin sections, are arranged for the use of the student. The course of instruction here is similar to that followed in the course in Mineralogy. Lectures are given upon the specimens of the typical collections, the method of classfiication explained, and the distinguishing characters of the different groups, species and varieties pointed out. Special attention is called to the variations and alterations in rocks and to their local modifications due to their special mode of occurrence in the field.

The object of the course is to give the student that training in the practical determination of rocks that will enable him to know them in the field and mine, as well as to observe their alterations and modifications—subjects that have a very important bearing upon the vital questions relating to ore deposits.

After the study of a sufficiently large number of types has been had, the student has assigned to him a large number of drawers containing unlabeled specimens of these rocks, which he is expected to determine and recite upon, as he has done in his study of minerals. The course is thus made thorough and practical, and adapted to the needs of the miner, teacher and geologist, giving them a training of which they can make use in their future work.

The student is drilled upon both the macroscopic and microscopic characters of the rock he is studying. The thin sections of rocks for the most part have been made at the College from the hand specimens in the Lecture Collection of Rocks. All practical students of Petrography will recognize the great advantage of this arrangement.

C. *Petrology:* Under this subdivision of Petrography, the various questions relating to the origin, modes of occurrence, relations and alterations of rocks, as observed in the field, are considered, but since the chief portion of the students electing Petrography also elect Physical and Chemical Geology, the majority of the instruction in Petrology is given in connection with that subject.

The entire subject of Petrography is to be taken as a whole, and the student is required to have passed in B 1 (Physics), F 1 (General Chemistry), and W 2 (Mineralogy). W 3 (Mineralogy) and B 5 (Light) must precede or accompany this subject.

In the above course in Petrography the following collections are used:

I. THIN SECTIONS OF MINERALS AND ROCKS.

Sections of Minerals	2,500
Polariscope Sections	132
Sections of Lecture Rock Collection	2,870
Sections of Michigan Rocks	1,000
Sections of Rosenbusch Rock Collection	983
Sections of Other Foreign Rocks	120
Miscellaneous Sections	354
Sections of Stratigraphical Rock Collection	210
Sections of Duplicates of Michigan Geological Survey Collection	260
Sections of Rocks Illustrating L. S. Monographs	86
Sections of U. S. Educational Series	60
Sections of Private Collection of A. E. Seaman	150
Sections of Norwegian Rocks	42
Sections of Saxonian Rocks	75
Sections of Arkansas and Wyoming Rocks	35
	8,877

adapted to the needs of the explorer, the teacher, the engineer, the petrographer, the geologist, the miner, the quarryman, and all others who desire to understand the connection and the structural relations that rock masses have to one another and to the valuable deposits which they may contain. It treats of the origin and alterations of rocks, of general volcanic and earthquake action, metamorphism, jointing, faulting, cleavage, mountain building, eruptive rocks and crystalline schists; the action of air, surface and underground waters, and life; the interior condition of the earth, etc., especially in their relations to the problems that the economic geologist, miner and quarryman have to meet. The student has brought before him constantly the various problems that arise in practical work and the methods of their solution.

This course enlarges and completes much that is briefly touched upon in the Principles of Geology and in Petrography.

The text-book used is Dr. Archibald Geikie's Text-Book of Geology, third edition, 1893, books I, II, III, IV and VII.

Students who take this subject must have completed B 1 (Physics), F 1 (General Chemistry), and W 2 (Mineralogy), and X 1 (Petrography), Y 2 (Stratigraphical Geology), and W 3 (Mineralogy) must precede or accompany this subject.

Y. 4. Geological Field Work.

Professor Seaman and Dr. Wright.

Forty-five hours a week for the last six weeks of the summer term. To count as one credit. The instruction in this subject begins about the middle of July, and consists of six weeks' practical work in the field, mostly amongst the pre-Cambrian rocks of the Lake Superior region.

The first few days of the course are spent at compass work, in which the student is trained in pacing and in the use of the dial and dip compass and aneroid barometer. This work consists of running section lines, meandering forest roads and streams, running contour lines, platting outcrops; in fact, making a complete map of the traverses. Specimens are collected and must be located with reference to some section corner or other monument established by the United States linear survey. On this work the student plats all of his work in the field, keeping his latitude and departure by means of his compass course and pacing.

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(Y 4) only, should have a fair knowledge of Mineralogy, Lithology and General Geology, if they wish to fully profit by the course. The other students at the College who are candidates for degrees, in order to elect this subject are required to have passed in Q 1 (Surveying), Q 4 (Topographical Drawing), W 3 (Mineralogy), Y 2 (Stratigraphical Geology), and Y 3 (Physical Geology).

Y 5. Economic Geology.

Professor SEAMAN.

Three times a week, twenty-eight weeks. To count as nine-tenths of a credit. In this subject the instruction will take up the geology of the useful, or economic, mineral products of the earth, considered from two different points of view.

1st. Their origin and mode of occurrence.

2nd. Their various uses.

The different theories of deposition will be discussed, and examples given which seem best to illustrate these theories.

During the fall and winter terms, the students are required to make abstracts of various articles assigned to them, and the abstracts are read and discussed in the class room.

The laboratory is fairly well equipped with material, such as ores, building stone, etc. The ores are arranged, showing gangue, and country rock where possible, so that students can get a better idea of the mode of occurrence, and association of the ore.

The following list will give some idea of the scope of this course, and of the materials available for its illustration.

Iron Ore samples, many with analysis	300
Copper ore, foreign and domestic	350
Lead and Zinc ores	120
Silver and Silver ore	225
Gold and Silver ores	465
Lesser Metals and ores, including Al., Sb., As., Bi., Cr., Mn., Hg., Ni., Co., Pt., Sn., etc	325
Coal, Coke, Petroleum etc	60
Salts and saline earths	70
Miscellaneous, including lubricants, abrasives, fertilizers, medicines and materials for the ceramic arts	225
Polished marbles	225
Polished Serpentine	80

[redacted]

Polished Ornamental Stones, other than the above..... 50
Building Stone, including granite, sandstone, limestone, slate, etc. 100

This course must be preceded by W 3 (Mineralogy), X 1 (Petrography), and Y 4 (Field Geology).

J. THESIS.

The Faculty.

J 1. Thesis.

Properly qualified students may include the preparation of a thesis in their work for a degree.

The subject of such thesis must be announced with the schedule of studies for the year in which the degree is expected; further, the elective schedule must be approved by the head of the department in which the thesis work is to be done. This approval will include the subject chosen and the student's preparation to do the work.

The schedule and subject are then considered by the Faculty, whose approval is necessary.

The thesis must be completed by July 1, and submitted to the Faculty for examination and acceptance. For its acceptance it must be accompanied with a written approval of the instructors under whom the work was done.

Degrees

The approximate unit of credit is assumed to be three hours a week in classroom (approximately nine hours of total work) or nine hours a week in the laboratory for thirty-three weeks. A subject scheduled for more or less time than here indicated takes its proportionate credit. No partially completed course may be accepted for credit either in whole or in part. The College is in session for four terms each year. It is therefore possible for a properly prepared student to cover the ordinary twelve term course in three years.

Three degrees are offered by the College as follows:

Bachelor of Science, B. S.

Engineer of Mines, E. M.

Doctor of Philosophy, Ph. D.

The conditions under which the first two are given are as follows:

To obtain either degree the candidate must have been a resident student of this institution for at least one full year of forty-five weeks.

All candidates for the degree of Bachelor of Science are required to obtain twenty credits, including subjects R 1 (Principles of Mining) and Y 1 (Principles of Geology).

All candidates for the degree of Engineer of Mines are required to obtain twenty-five credits, including subjects R 1 (Principles of Mining) and Y 1 (Principles of Geology).

All students who have been granted the degree of Engineer of Mines may obtain the Bachelor of Science degree on payment of the required fee.

All students who graduated from this institution prior to 1896, with the degree of Bachelor of Science, may receive the degree of Engineer of Mines, on the presentation of evidence showing five years of subsequent successful practical work, submitting a satisfactory thesis, and paying the required fee.

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Employment

To one contemplating entering upon training for any particular profession, the question, will it pay? is one of deep and often of disproportionate interest. In reference to a Mining Engineering training this question generally resolves itself into the more specific inquiry: what are the chances of obtaining a position upon graduation? Regarding this question it may be said that, with the increasing interest in mines and mining, in this and other countries, the demand for competent mining men is on the increase, and at the present time it seems that Mining Engineering offers opportunities at least as wide as are offered by any other line of engineering.

It should be clearly understood that the Michigan College of Mines makes no promise whatever to secure positions for its graduates. Upon graduation each man goes into the market to sell his services on a level with every other technical graduate in mining, whether prepared at this or another college. At the same time the College takes an interest in its graduates. Each one is urged to keep the institution informed of his whereabouts, his work, and whether or not he desires a change. From information thus gained a record is made and kept as nearly up to date as possible. When the College is asked to recommend a man for a given position, this record is looked over and the most avalilable man is selected from it. In no case is a man recommended merely because he is a graduate of this institution. In selecting him his experience, his character and his general ability, both as shown in his work as a student and in his career after he leaves the College, are taken into account. His defects, if known, are stated as carefully as are his aptitudes or excellencies, and no one is recommended unless he is deemed fit for the position.

Prospective students and those responsible for them should un-

Library

The Library, located on the second floor of Hubbell Hall, is designed to supplement the class work in the various departments of the College. Care has been taken to supply it with the best reference books as well as with the latest publications on the subjects taught, since it is of prime importance that instructors and students shall have access to the results of the most recent researches in scientific and technical lines. It should be noted in this connection that there is no other Library in the vicinity to which those needing such information can apply. The Library is especially rich in files of journals relating to the various branches of mining engineering. Upon its shelves may be found complete sets of such journals as Transactions of the American Institute of Mining Engineers, Annales des Mines, Jahrbuch fur das Berg-Huetten und Salinenwesen, Journal of the Iron and Steel Institute, Philosophical Transactions of the Royal Society of London, Proceedings of the Royal Society of London, Wiedemann's Annalen der Physik und Chemie, Zeitschrift fur Analytische Chemie, Transactions of the American Society of Mechanical Engineers, Zeitschrift des Vereins deutscher Ingenieure, and many others of like character.

The Library is equipped with steel stacks. The classification is an adaptation of the Dewey decimal system to the needs of a technical library, and a card catalogue of authors and subjects is being prepared.

There are now on the shelves 17,690 volumes. The Library receives as gifts a number of United States documents and reports of various state geological surveys and mining bureaus. Such material is very useful, and grateful acknowledgement is made for all contributions of scientific value.

Beside the bound volumes on the shelves, the library contains over 4,000 pamphlets, classified and accessible for reference, and a large number of maps.

The Library is open daily throughout the year, Sundays and legal holidays excepted. While it is intended primarily as an aid to college work, the College authorities are pleased to extend its privileges to such part of the general public as may wish to use it. Mining engineers, and those interested in scientific or technical pursuits, will find it a valuable aid in their research. The library now receives 241 technical and scientific periodicals, which are issued upon application for use in the reading room which adjoins the library.

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Buildings

The laboratories and the Library of the College together with its lecture and recitation rooms at present occupy six buildings.

Hubbell Hall, formerly known as Science Hall, is constructed of Portage Entry sandstone and has extreme dimensions of 109 by 53 feet, with a wing 37 by 25 feet. It contains the executive offices, the Library and Reading Room, and the laboratories and lecture rooms of the departments of Geology, and of Mathematics and Physics.

The Physical laboratories are located on the ground floor. They have been recently fitted up with modern conveniences for laboratory instruction. There is a massive pier for instruments requiring extreme stability, while slate shelves firmly attached to the thick basement walls afford very stable supports for galvanometers and other like instruments. These rooms contain many features especially designed by the instructors in charge to meet the peculiar needs of this department. They are well lighted and well adapted to their purpose.

On this floor in the tower is a constant temperature and dark room surrounded by thick stone walls. It is used partly for work in light, and partly for electrical and other measurements where a steady temperature is desirable.

The Physical lecture room is located on the second floor of this building and contains a convenient lecture table fitted with electrical, gas and water supply.

The laboratories of the department of Geology and Mineralogy together with the necessary offices occupy the entire first floor.

The Library, Reading Room and executive offices are on the second floor, while the Mathematical lecture and recitation rooms and a Geology and Mineralogy Museum occupy the entire third floor.

A list of the principal rooms in this building follows:

BASEMENT.

Student's Room	16x33 feet
Gymnasium	31x34 feet
Constant Temperature and Dark Room	14x19 feet
Electrical Laboratory	31x42 feet
Physical Laboratory	32x41 feet

FIRST FLOOR.

Laboratory of Economic Geology	22x27 feet
Palæontological Laboratory	21x27 feet
Geological Laboratory	21x27 feet
Mineralogical Laboratory	27x40 feet
Petrographical Laboratory	24x23 feet
Goniometer Room	7x16 feet
Petrographic Grinding Room	13x16 feet

SECOND FLOOR.

Library	29x49 feet
Office of Librarian and Secretary	14x21 feet
General Executive Office	15x26 feet
President's Room	14x21 feet
Reading Room	28x32 feet
Physical Lecture Room	33x41 feet

THIRD FLOOR.

Mathematical Lecture Room	43x32 feet
Recitation Room	15x26 feet
Geology and Mineralogy Museum	43x49 feet
Recitation Room	24x33 feet

The Mechanical Engineering Building, of brick and stone, is of the extreme dimensions 101x64 feet. It contains the rooms used by the department of Mechanical and Electrical Engineering. The Mechanical Drawing Room on the second floor of this building is an exceptionally well lighted room and well adapted for its purpose. A list of the principal rooms with sizes follows:

occupied by a supply room 15 by 13 feet and a weighing room 12 by 21 feet. In the eastern end of the building there is a parting room 10 by 21 feet, fitted with desks and hoods for the parting of gold and silver. This building connects by a covered passage way with the Chemical Building which adjoins it.

The Chemical Building is 115 by 45 feet, with wings 36 by 17 feet and 53 by 36 feet in size. It is a brick and stone structure of three stories in height.

The hoods in the Chemical Building have a ventilating system of their own in addition to the general one for the building thus ensuring the greatest freedom from chemical fumes in the tories and offices.

A list of the principal rooms follows:

BASEMENT.

General and Experimental Chemistry Laboratory	31½x51 feet
Laboratory for Metallurgical Experimentation	24x33 feet
Instructor's office	10x17 feet
Supply Clerk's office	17x23 feet

FIRST FLOOR.

Qualitative Laboratory	33x40 feet
Quantitative Laboratory	32x39 feet
Advanced Quantitative Laboratory	12x26 feet
Professor's Office and Laboratory	17x25 feet
Instructor's Office	14x18 feet
Weighing Room	12x16 feet
Gas Analysis Room	12x16 feet

SECOND FLOOR.

Metallurgical Designing Laboratory	23x26 feet
Apparatus Room	10x23 feet
Lecture Room	31x40 feet
Museum of Charts, Models, etc	31x34 feet

The Ore-Dressing Building is a wooden structure with main part 30 by 30 feet, two stories in height and an extension 51 by 30 feet. It occupies a slope on the eastern side of the College grounds which gives the requisite fall for gravity processes.

There is also a Reverberatory Roasting Furnace in a wooden building 28 by 28 feet. This furnace is operated in connection with the Ore-Dressing mill.

The Mining Engineering Building is 134 by 53 feet, three stories in height, and is built of brick and stone. In the center of the building there is a tower which carries a large steel tank at the top, thus providing a water supply for the Hydraulic Laboratory which is located in this building. In addition to the list of principal rooms which follows, there are eight floors in the tower which are used for Hydraulic experimental work:

[redacted]

BASEMENT.

Hydraulic Laboratory	68x45 feet
Mining Laboratory	61x24 feet

FIRST FLOOR.

Draughting and Instrument Room	25x136 feet
Coat Room	15x20 feet
Supply Room	15x20 feet
Assistant's Office	10x14 feet

SECOND FLOOR.

Lecture Room	54x25 feet
Model Room	44x25 feet
Recitation Room	31x25 feet
Blue Print Room	15x20 feet
Professor's Office	13x14 feet

The Michigan legislature of 1903 has passed a bill making an appropriation of $45,000 for a metallurgical building at the College of Mines. This building will be constructed as rapidly as circumstances will permit and it is hoped will be ready for use not later than the opening of the fall term of 1904.

It will be equipped with a complete line of furnaces, large and small, together with accessory apparatus for the conduct of various metallurgical operations and experiments. In addition, it is expected to fit up cyanide and lixiviation plants of such a nature as to afford the student practice in these processes.

Beside the appropriation for the metallurgical building, the Legislature has granted $9,000 for completing and extending the equipment of the Mining Engineering Building ; $4,000 for completing the equipment of the Chemical Building; $2,000 for fitting up a Geological Museum, and $1,000 for extending the equipment of the Mechanical Engineering shops. It is expected that these extensions will be completed by the opening of the next Fall term of 1903.

All expenses for breakage or damage to apparatus will be paid for by the student as the laboratory fees do not cover these items.

The matriculation and laboratory fees for the course of study elected must be paid on entrance to the College. The full tuition fee for Michigan students must be paid on entrance; but other students are required to pay the proportionate part of the tuition fee at the commencement of each term, for that term as follows: Fall, Winter and Summer terms, $40.00 each term. Spring term, $30.00.

No partial fees are to be accepted, and any fee once paid will not be refunded except in the case of protracted illness.

A student suspended, dismissed or expelled from, or voluntarily withdrawing from, a class, laboratory, or the college, will forfeit his fees already paid.

In order partially to insure the state against damage and loss to its College property every student is required to deposit with the treasurer before entering the College, the sum of twenty-five dollars ($25). This sum cannot be withdrawn by the student until he closes his connection with the institution, and if any portion is required as a refund for damages, the part withdrawn shall be at once replaced by the student.

Charges for apparatus, chemicals and other supplies from the store room, as well as for repairs of damages to College property, and also fines, are deducted from coupons procurable from the secretary, but no portion of the deposit of twenty-five dollars shall be used for the purchase of these coupons. The coupons can be used only for the purposes mentioned, and not for the payment of any fees. The permanent deposit of twenty-five dollars, together with any balance equivalent to the unused portion of a coupon, is returned to the student when he closes his connection with the institution.

There are no dormitories connected with the College. Arrangements can be made to obtain board and room in private families, and in boarding houses, in Houghton and Hancock, at prices varying from twenty-seven dollars per calendar month upward. This is to include the room, heat and lights, as well as board. Board alone can be obtained at about twenty dollars per calendar month. The College expenses vary much with the taste and habits of the student.

properly occupy his time, he may be required to take additional subjects. If a student has elected more work than he can properly perform he may be required to drop some of the subjects.

Each instructor is the sole judge of the fitness of every student electing his subjects. He may refuse to admit into his class any student found deficient in preparation, or dismiss him from his courses at any time when his conduct or work is unsatisfactory.

Absences.—All absences bring a daily mark of zero, until the work missed is made up.

A student absenting himself without excuse for more than ten per cent. of the work of any course in any term thereby dismisses himself from the College. In the case of field or laboratory courses, the limit is 5 per cent. instead of ten per cent.

Passing Grade.—A student must obtain a grade of 75 on the scale of 100 to obtain credit for any course. In case of failure to pass or complete a subject, the work can be made up only when this subject is being regularly given.

Failure.—A student who fails in three subjects or who receives conditions in three subjects in any year's work, is thereby suspended from the College.

Laboratories.—The laboratories close Friday evening the closing day of each term, and re-open on Monday morning after the recesses.

In conformity with the foregoing letter, the Board of Control have decided upon the following subjects and conditions:

SUBJECTS.

1. Field Geology; its Methods and their Applications.
2. The Dial and the Dip Compass and their Uses.
3. The Diamond Drill and its Uses.

CONDITIONS.

The conditions under which the prizes are awarded are as follows:

The papers are to be presented by August 15th, for each year.

A student may present a paper upon each of the three subjects, which will entitle him to three prizes, if his papers are found worthy.

The dissertations must be prepared in the same manner as the theses, the regulations for which can be procured on application to the Secretary of the College.

The title page is to have upon it an assumed name, and each paper is to be accompanied with a sealed envelope bearing the same name. This envelope must contain the writer's true, as well as assumed name, and his address. It will not be opened until the awards have been made.

No prizes will be awarded, unless the papers are judged by the committee to whom they are referred, to be of a sufficiently high standing to be entitled to a prize; hence, there may be awarded all, part, or none of the prizes, as the case may be.

These prizes can now be competed for by any students of the College, whether special, graduate or regular, without restriction to the graduating class, as was originally specified.

THE CHARLES E. WRIGHT SCHOLARSHIP.

The Charles E. Wright Scholarship was founded by Mrs. Carrie A. Wright, of Ann Arbor, in accordance with the conditions expressed in the letter which follows:

[redacted]

to some graduate who has made application for it, and who has shown sufficient proficiency in mechanical lines to warrant his receiving it.

Application should be made to the Faculty as early as July 15th of each year in which the student expects his degree.

MICHIGAN LOAN SCHOLARSHIPS.

By virtue of the power conferred by Act No. 81, Public Acts of 1897, the Board of Control have established twelve scholarships under the above title. These are open to Michigan students under the following regulations:

The scholarship may be granted by the Faculty of the College to students who are bona-fide residents of the State of Michigan, who have completed at least three terms of study at the College of Mines, who have during this entire time a good record as to character and work as students, and who are deemed deserving and needy.

Each scholarship is to be granted for the College year or the unexpired portion thereof, but the same student may at the option of the Faculty receive the grant more than once.

Each scholarship shall remit to the recipient the tuition and laboratory fees for the time for which he holds it, provided, however, the amount so remitted shall not exceed $75 in any one college year.

If at any time the work or conduct of the holder of one of these scholarships becomes unsatisfactory to the Faculty, he shall be deemed to have forfeited the scholarship.

Upon receiving the grant of a scholarship, the recipient shall give his note for the amount of same. The note shall bear interest at the rate of six per cent. per annum from the date of his leaving the College until paid, and shall be due on or before five (5) years from such date.

Amounts paid on such notes shall constitute a fund to be known as the Loan Scholarship Fund, which fund shall be devoted to assisting needy and worthy students by cash loans.

LOAN FUND ASSOCIATIONS.

Act 250, Public Acts 1899, provides for the incorporation of associations for the purpose of establishing loan funds for the benefit

of students who wish to attend any one of five of the State Educational institutions, among which is included the College of Mines.

Under this Act at least one such association has been incorporated. It is known as the Genessee Students' Loan Fund Association. Its headquarters are at Flint. This association wisely aims to aid the student by helping him to help himself in so far as it is possible to do so. It will aid students to attend any one of the institutions mentioned in the Act. Information about it may be obtained by addressing Dr. Rachel J. Davidson, Flint, Mich.

It is to be hoped that other associations of like nature may be formed and that like this one they will attempt to give the encouragement toward self help which so often keeps up the courage of the student dependent upon his own resources.

This College is frequently appealed to by worthy young men who desire to work their way through. They are not appealing for charity but only for opportunity. Such associations by helping earnest young men to find the opportunity to work would render them and the institutions in which they become students lasting benefit.

Text Books

A. MATHEMATICS.

A 1. College Algebra. G. A. Wentworth. Ginn & Co., Boston.
A 2 and 3. Plane and Spherical Trigonometry. W. Wells. Heath & Co., Boston.
A 4. Analytic Geometry. Tanner and Allen. American Book Co., New York.
A 5. Manuscript Notes on Calculus. F. W. McNair.
A 5. Elements of the Calculus. J. M. Taylor. Ginn & Co., Boston.
A 6. A Treatise on Ordinary and Partial Differential Equations. W. W. Johnson. John Wiley & Sons, New York.

B. PHYSICS.

B 1 and 4. Manuscript Notes in Physics. F. W. McNair.
B 1 and 4. Laboratory Course in Physics. Last Edition. W. C. Sabine. Ginn & Co., Boston.
B 1 and 4. Heat and Light. R. T. Glazebrook. The Macmillan Co., New York.
B 1. Mechanics for Beginners. J. B. Lock. The Macmillan Co., New York.
B 2 and 3. A Laboratory Manual of Physics and Applied Electricity. E. L. Nichols. The Macmillan Co., New York.
B 2. Lessons on Elementary Practical Physics. Vols. I and II Balfour Stewart and W. W. Haldane Gee. The Macmillan Co., New York.
B 3. Electrical Measurements. H. S. Carhart and G. W. Patterson, Jr. Allyn & Bacon, Boston.

C. MECHANICS.

C 1 and 2. Mechanics of Engineering. I. P. Church. John Wiley & Sons, New York.

F. CHEMISTRY.

F 1. Manuscript Notes on General Chemistry. George A. Koenig.
F 1. Inorganic Chemistry. Richter, Smith. P. Blakiston Son & Co., Philadelphia.
F 1. Manuscript Notes on Experimental Chemistry. G. A. Koenig.
F 1. Treatise on Chemistry. Roscoe & Schorlemmer. D. Appleton & Co., New York.

[redacted]

M 3. Principles of Mechanism. S. W. Robinson. J. Wiley & Sons, New York.

M 4. Text-Book on the Mechanics of Materials. Mansfield Merriman. John Wiley & Sons, New York.

M 5. The Mechanical Engineering of Power Plants. F. R. Hutton. John Wiley & Sons, New York.

M 6. Hydraulic Cement. F. P. Spaulding. John Wiley & Sons, New York.

M 9. Experimental Engineering. R. C. Carpenter. John Wiley & Sons, New York.

M 10. Pumping Machinery. W. M. Barr. J. B. Lippincott Co., Philadelphia.

M 10. Mechanical Engineer's Pocket Book. W. Kent. J. Wiley & Sons, New York.

M 15. Lettering for Draughtsmen. C. W. Reinhardt. D. Van Nostrand, New York.

M 15. Elements of Mechanical Drawing. Last Edition. G. C. Anthony. D. C. Heath & Co., Boston.

M 16. Machine Drawing. Last Edition. G. C. Anthony. D. C. Heath & Co., Boston.

M 16.—Manual of Machine Drawing and Design. Last Edition. D. A. Low and A. W. Bevis. Longmans, Green & Co., New York.

M 16.—Elements of Machine Design. Latest Edition. W. C. Unwin. Longmans, Green & Co., New York.

N. ELECTRICAL ENGINEERING.

N 1.—Incandescent Wiring Hand Book. T. B. Badt. Electrical Publishing Co., Chicago.

N 1. Electrical Engineering. W. Slingo & Brooker. Longmans, Green & Co., New York.

Q. CIVIL ENGINEERING.

Q 1, 4 and 5. Theory and Practice of Surveying. Last Edition. J. B. Johnson. John Wiley & Sons, New York.

Q 1. Field Engineering. Last Edition. William H. Searle. John Wiley & Sons, New York.

Q 2 and 3. A Treatise on Hydraulics. Last Edition. Mansfield Merriman. John Wiley & Sons, New York.

Q 4 and 5. The Theory and Practice of Lettering. C. E. Sherman, Columbus, Ohio.

Q 4. A Practical System of Freehand Lettering. Charles W. Reinhardt. D. Van Nostrand Co., New York.

Q 6. Graphical Analysis of Roof Trusses. Last Edition. Charles E. Green. John Wiley & Sons, New York.

R. MINING ENGINEERING.

R 1. A Text-Book of Ore and Stone Mining. Last Edition. C. LeNeve Foster. C. Griffin & Co., London.

R 2. Manuscript Notes on Mine Surveying and Mining. Revised, 1901. F. W. Sperr.

R 4.—Manuscript Notes on Mine Engineering. Revised, 1903. F. W. Sperr. ..

R 5. Manuscript Notes on Mine Management and Accounts. Revised, 1903. F. W. Sperr.

S. ORE DRESSING.

S 1. Manuscript Notes on Ore Dressing. 1895. F. W. Sperr.

V. BIOLOGY.

V 2. Comparative Zoology. 1895. James Orton. Harper & Bros., New York.

V 2. A Text-Book of Palaeontology. 1900. Karl Von Zittel. Translated by Charles R. Eastman. The Macmillan Co., New York.

W. MINERALOGY.

W 1.—Elements of Crystallography. Last Edition. G. H. Williams, H. Holt & Co., New York.

W 2. The System of Mineralogy. Sixth Edition. 1892. James D. Dana and E. S. Dana. John Wiley & Sons, New York.

W 2. Practical Determination of Minerals—Manuscript. 1876-1892. M. E. Wadsworth.

X. PETROGRAPHY.

X 1. Introduction of Optical and Microscopic Mineralogy—Manuscript. 1877-1893. M. E. Wadsworth.

X 1. Microscopical Physiography of the Rock Making Minerals. Third Edition. 1893. H. Rosenbuch. Translated by J. P. Iddings. John Wiley & Sons, New York.

Busch, Elmer George....................................Alma, Wis.
Drew, Charles Verner, S. B., (University of Chicago) Chicago, Ill.
Ealy, Rush Chambers..................................Chicago, Ill.
Fisher, Harry White..........................San Francisco, Cal.
Horton, Albert Cary...............................Grand Rapids.
Myers, Albert ....Phoenix
Pitner, Paul Jerome................................Boston, Mass.
Sperr, Frederick William, Jr............................Houghton.
Stevenson, Elliott Kimball..........................Port Huron.
Winckler, Anton Lange..................................Houghton.
Wood, Smith Palmer.......................................Saginaw.

Register of Students, 1902-1903

Adams, Clement Lawerson,	*Sault Ste. Marie.*
Anderson, Fred Harrison,	*Detroit.*
Anderson, Merton Baird,	*Calumet.*
Anderson, Robert Hutchison,	*Southerton, Kirkcaldy, Scot.*
Andrew, Alexander G., Jr.,	*Calumet.*
Andros, Stephen Osgood, B. A. (Bowdoin College),	*Detroit.*
Arnold, Leo Frank,	*Chicago, Ill.*
Atwood, Ernest Preston Brown, A. B. (Brown University),	*Detroit.*
Avery, Charles Dwight,	*Minneapolis, Minn.*
Avery, Waldo Allard, Jr.,	*Detroit.*
Baggaley, Robert Alden,	*Pittsburg, Pa.*
Bailey, Alfred Colin	*Sault Ste. Mari.*
Baker, John C., A. B., A. M. (Northwestern University),	*Springfield, Ill.*
Barabe, Clifford Aloysius,	*Houghton.*
Bartlett, Hiram Lawrence,	*Harbor Beach.*
Batchelder, Benjamin Warren, Jr.,	*Iron Mountain.*
Bauder, William Ralph,	*Chicago, Ill.*
Baugh, Samuel Andrew, Jr.,	*Detroit.*
Beamer, Richard Hunter,	*Spokane, Wash.*
Bennett, Prescott Doughty,	*Oak Park, Ill.*
Benson, Anthony Fred,	*South Lake Linden*
Black, Robert Moffitt, A. B. (Harvard University),	*Richmond, Va.*
Boorhem, Shelby Martin,	*Grand Rapids.*
Botsford, George Blandy,	*Houghton.*
Botsford, Heman,	*Houghton.*
Bowen, Herbert Powers,	*Detroit.*
Bowen, Winfred Graves,	*Detroit.*
Brooks, Alan M.,	*Minneapolis, Minn.*
Brooks, George Sage,	*Milwaukee, Wis.*
Brown, Rufus Arthur,	*Toledo, Ohio.*

., ..dwin J.,	*Minneapolis, Minn.*
Cotton, Charles Stanhope,	*Detroit.*
Cram, Frederick William,	*Escanaba.*
Curtis, George Doyle,	*Butte City, Mont.*
Daue, Edwin Oliver,	*Houghton.*
Davidson Arthur John,	*Grand Rapids.*
Devine, Henry Edward,	*Ishpeming.*
DeWilde, Felix Julius,	*Sheboygan, Wis.*
Dickerson, Leonard Roy,	*Escanaba.*
Dodge, Charles Warren, Jr.,	*Milwaukee, Wis.*
Donahoe, Dennis Gregory,	*Ishpeming.*
Donahoe, Francis Timothy,	*Ishpeming.*
Douglass, Thomas J., Jr.,	*Los Angeles, Cal.*
Drew, Charles Verner, S. B. (University of Chicago),	*Chicago, Ill.*
Dunstan, James Samuel,	*Hancock.*
Dunstan, Robert Peel,	*Hancock.*
Dunster, Carl Bennett,	*Bad Axe.*
Dykema, William P.,	*Grand Rapids.*
Eichhorn, Clarence Carl,	*Port Huron.*
Emrey, George Leitch,	*Manistee.*
Ephraim, Harry Myer,	*Flint.*
Farrell, George Wellington,	*Rockford.*

Fink, William Nelson,	*Milwaukee, Wis.*
Flaherty, Robert Joseph,	*Port Arthur, Canada.*
Forbes, Carroll Ralph, B. S. (Michigan College of Mines),	*Topeka, Kan.*
Foster, Clement Albert, B. S. (Michigan College of Mines),	*Rockford.*
Foster, Lewis Erwin,	*Saginaw.*
Fox, Arthur Christ,	*Houghton.*
Furbeck, Philip John,	*Oak Park, Ill.*
Garrey, George Henry, S.B., M.S. (University of Chicago),	*Chicago, Ill.*
Gates, Charles Cassius,	*Clarkston.*
Gibbs, Charles Howard,	*Houghton.*
Goodman, Francis Benjamin,	*Sands.*
Gordon, William Crosgrove, B. A. (McMaster University),	*Port Rowan, Canada.*
Graham, John Fraser,	*Detroit.*
Grice, John Marriott,	*St. Louis, Mo.*
Haagsma, Orland,	*Chicago, Ill.*
Harrington, Louis Clare,	*Ludington.*
Hasselbring, Albrecht,	*Flint.*
Hermann, Edward Leo,	*Calumet.*
Hoar, William Bennett, Jr.,	*Houghton.*
Hodge, Walter Roberts,	*Houghton.*
Holbert, Gabriel Sherwood, B. S. (Michigan College of Mines),	*St. Clair.*
Holman, James Pattison,	*Seattle, Wash.*
Holmes, J. Allison,	*Houghton.*
Hopkins, Herman Halsey, Jr.,	*Oak Park, Ill.*
Horton, Albert Cary, Jr.,	*Grand Rapids*
Ireland, Alexander Lee, B. A. (Trinity College), B. S. (Michigan College of Mines),	*Toronto, Canada.*
Jacka, John,	*Calumet.*
Jewett, Norman Ralph,	*Richland.*
Johnson, Clifton Beach, Ph.B. (Beloit College),	*Beloit, Wis.*
Johnson, John Saras,	*Calumet.*
Johnson, Ralph Browning,	*Houghton.*
Jordan, Fred Allen,	*Ottawa, Ill.*

Summary of Students, 1902-1903

BY STATES AND COUNTRIES.

Arizona	1
California	2
Canada	3
Connecticut	1
England	2
Idaho	1
Illinois	19
Iowa	2
Kansas	2
Michigan—{ Upper, 75 / Lower, 67 }	142
Minnesota	7
Missouri	3
Montana	1
New Jersey	1
New York	2
Ohio	2
Peru	1
Pennsylvania	1
Scotland	1
Utah	1
Virginia	1
Washington	3
Wisconsin	11
Total	210

Average Age of Students, 1902-03 .... 22 years, 4 months

an
of the College, are as follows:

Assistant Engineer, Butte and Boston Mining Co., Butte, Mont. Engineer, Compania Minera de Penoles. *Mapimi, Durango, Mex.*

Blackwell, Frank, B. S., 1897, E. M., 1898. Chemist, Commonwealth Mine, Commonwealth, Wis. Mining Engineer, Oliver Mine, Mountain Iron, Minn. Mining Engineer, Vermilion Iron Range, for Oliver Iron Mining Co. Manager Northwestern Development Syndicate, Ltd., Goldfields, B. C. *Goldfields, B. C.*

Blair, Arthur Eddlmund, E. M., 1898. Engineer and Chemist, Commonwealth Iron Co., Commonwealth, Wis. Engineer and Draughtsman Washoe Copper Co., Anaconda, Mont. Engineer and Chemist, Carissa Gold Mining Co., South Pass City, Wyo. Mining Engineer with Chas. W. Clark, Butte, Mont. Mining Engineer Boston-Montana Mining Co., Butte, Mont. *Butte, Mont.*

Bossert, Otto Henry, E. M., 1891. Student at the Bergakademie, Freiberg, Saxony. Assayer, Bingham Canyon, Utah. U. S. Deputy Mineral Surveyor and Mining Engineer, Salt Lake City, Utah. Superintendent,

[redacted]

NAME. OCCUPATION. ADDRESS.

Davis, Charles Stanley, E. M., 1899. Assistant Mining Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Mining Engineer, Mexican Gold and Silver Recovery Co. Ltd., of London. *El Oro, Tultenango, Mex.*

Davis, Frederick Llewellyn, B. S., E. M., 1900. Mining Engineer. *Salt Lake City, Utah.*

Davis, Robert Cornell, B. S., E. M., 1902. Assistant to Engineer, Anaconda Copper Mining Co., Butte, Mont. *Butte, Mont.*

Deane, Elbridge Gerry, B. S., E. M., 1901. Transitman, Buffalo-Rochester Railway Survey, Buffalo, N. Y. Assistant Engineer at Pioneer, Zenith, Sibley and Savoy Mines, Oliver Iron Mining Co., Ely, Minn. Engineer Chandler Iron Co., Ely, Minn. *Ely, St. Louis Co., Minn.*

Dengler, Theodore, E. M., 1891. Mining Engineer, Millie Iron Mine Iron, Mountain, Mich. Inspector, U S. Engineers, Portage Lake Ship Canals, Houghton, Mich. Mining and Civil Engineer, Atlantic Mine, Mich. Consulting Mining Engineer (Croze & Dengler), Denver, Colo. Chief Engineer, Atlantic, Baltic, Central and Phoenix Mines.—County Surveyor. *Atlantic Mine.*

Dewey, Franklin Smith, B. S., E. M., 1901. Mining Engineer, Union Gold Mining Co., Crown King, Ariz. Assistant Secretary, National Protective Society, Detroit, Mich. *Detroit.*

Dickinson, Edmund Sargent, E. M., 1899. Assistant Mining Engineer, Aragon, Traders, Commonwealth and Bristol Mines. Assistant Chemist, Aragon and Traders Mine, Commonwealth Iron Co., Norway, Mich. Assistant

Park City, Utah.

Eby, John Henry, E. M., 1894. Civil Engineer and Draughtsman for Pennsylvania Traction Co., Lancaster, Pa. Draughtsman for Slaymaker and Henderson, Civil Engineers, Lancaster, Pa. Mining Engineer, Minnesota Mine of the Minnesota Iron Co., Soudan, Minn. Assistant Superintendent, Columbia-Menona Mines, Smuggler, Colo. Assistant to Engineer, Southern Pacific Co., Construction Corps, Tucson, Ariz. Assistant Engineer, Los Angeles Div. Southern Pacific Co., Los Angeles, Cal. Roadmaster, Southern Pacific Co., Gila Bend, Ariz. Roadmaster Southern Pacific Co., Alameda, Cal.
Alameda, Cal.

Edwards, Robert Leverich, E. M., 1899. Draughtsman, Lake Superior Smelting Works, Dollar Bay, Mich. Manager, Pontiac Mining Co., Comaplix, B. C. Manager, Kittie Burton Gold Mines Co., Lemhi County, Idaho.
Ulysses, Idaho.

Emlaw, Harlan Stigand, B. S., E. M., 1895. Draughtsman Midland Terminal Railway, Cripple Creek, Colo.

age Lake Foundry Machine Co. Timberman, Calumet and Hecla Mine, Calumet, Mich. Assistant Mining Captain, Amygdaloid Mine, Calumet & Hecla Mining Co. Reporting Engineer, Port Arthur, Ontario, Can. Fee-Owner's Agent, Dunn, Crystal Falls, Columbia and Tobin Mines. *Crystal Fa*

Figueroa, Camilo (A. B., St. Mary's College), B. S., E. M., 1897. Mining Engineer, Exploradora Mine, Sierra Mojada, Mex. Chemist and Assayer for Salvador malo Concepcion del Oro, Zac, Mexico. Representative Engineer of the La Carmaguense, Zaragoza and El Carmen Mining Cos. El Carmen Mines, Coahuila, Mex. Mining Engineer, Parral, Chichuahua, Mex. ·r for the Santa Rosa Mines of the Mexican Syndicate, Mazapil, Zacatecas, Mex. Engineer Santa Rosa Mines of the Santa Rosa de Maza-ing Co., Mazapil, Zac., Mex. *Mazapil, Zacatecas, M*

), E. M., 1891. (Ph. D., University of Berne).

NAME. OCCUPATION. ADDRESS.

Chemist and Metallurgist, with Geo. W. Goetz, Milwaukee, Wis. Organic and Technical Chemistry, Polytechnische Hochschule, Charlottenburg, Prussia, Student, University of Berne, Switerland. Chemist and Metallurgist with George W. Goetz, Milwaukee, Wis. President, Fink Chemical Co., Milwaukee, Wis. Consulting Engineer, Milwaukee, Wis. *Milwaukee, Wis.*

FISHER, JAMES, JR., E. M., 1893. Draughtsman, Lake Superior Iron Works, Hancock, Mich. Instructor in Mathematics and Physics, Michigan College of Mines. Assistant Professor of Mathematics and Physics, Michigan College of Mines. *Houghton.*

FORBES, CARROLL RALPH, B. S., 1902. Assistant in Mechanical and Mining Engineering, Michigan College of Mines. *Houghton.*

FLOETER, ALBERT HENRY, B. S., E. M., 1898. Assistant Engineer, Wis. & Mich. Ry. Engineering Corps, Norway, Mich. Transitman, Copper Range Survey, Houghton, Mich. Assistant Mining Engineer, Arcadian Copper Co., Arcadian Mine, Mich. Assistant Superintendent, Atlantic and Baltic Stamp Mill, Redridge, Mich. Engineer in charge of Construction of Redridge Dam, Redridge, Mich. Mining Engineer, Phoenix Consolidated Copper Company, Phoenix Mine, Mich. Superintendent and Mining Engineer, Northwestern Development Syndicate, Ltd., Goldfields, B. C. *Goldfields, B. C.*

FORMIS, ANDRE, B. S., 1899, E. M., 1900. Assistant Mining Engineer, Lake Superior Iron Co., and City Engineer, Ishpeming, Mich. *Ishpeming.*

FOSTER, CLEMENT ALBERT, B. S., 1902. Assistant Engineer, Tennessee Coal, Iron and R. R. Co., Bessemer, Ala. *Bessemer, Ala.*

FRANKE, EMIL ARTHUR, B. S., 1899, E. M., 1900. Instructor

Assayer and Draughtsman, Montana Ore Purchasing Co., Butte City, Mont. Assayer Lost River Mining Co., Cliff, Custer Co., Idaho. Surveyor, Superintendent, W. A. Clark's properties, Butte City, Mont. Superintendent of Mines Parrot Silver and Copper Co., Butte City, Mont. Secretary and General Superintendent, Sioux Consolidated Mining Co., and Utah Consolidated Mining and Milling Co., Juab Co., Utah. General Manager, Farrel Copper Co., Butte, Mont.

Butte, Mont.

GOLDSWORTHY, JOHN MARTIN, B. S. 1900, E. M. 1901. Engineer, Pewabic Co. *Iron Mountain.*

GOODALE, GEORGE SILAS, B. S., 1899, E. M., 1900 Student Michigan College of Mines. Chemist and Assistant Engineer, Norrie Mines, Ironwood, Mich. Engineer, Trimountain Stamp Mill, Beacon Hill, Mich. Engineer, Victoria Copper Mining Co., Victoria, (Ontonagon Co.), Mich. *Victoria.*

GRANT, BURDETTE F., B. S., E. M., 1902. Mining Engineer

NAME. OCCUPATION. ADDRESS.

with U. S. Steel Corporation, operating mines on Mesaba Range, Pillsbury District, Hibbing, Minn. *Hibbing, Minn.*

GRAVES, MACDOWELL, B. S., E. M., 1896. Superintendent, Occidental Mine, Telluride, Colo. Superintendent of Mines for M. D. Graves y Cia, Mexico, D. F. Ocotlan, Edo de Oaxaca, Mex. Consulting Engineer, La Cia. Mexicana Manufacturera de Barro. Mining Engineer for Douglas, Lacey & Co., and Mexican Exploration and Development Co., Mexico, D. F. *Mexico City, Mex.*

GREENE, FRED TURRELL, B. S., E. M,. 1897. Assistant Draughtsman and Surveyor, Boston and Montana, and Butte and Boston Mining Cos., Butte, Mont. Assistant Superintendent and Mining Engineer, War Eagle Consolidated Mining and Development Co., Ltd., and Center Star Mining Co., Ltd., Rossland, B. C. Geologist with Anaconda Copper Mining Co., Washoe Copper Co., Parrot Mining Co., Colorado Smelting and Mining Co., Butte, Mont. *Butte, Mont.*

HAAS, JACOB C., B. S., 1889; E. M., 1890. Civil Engineer, Penokee and Gogebic Consolidated Mining Co., Ironwood, Mich. Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. Mining Engineer and Assayer, Midway, B. C. Mining Engineer, Midway, B. C. Mining Engineer, Greenwood, B. C., and Spokane, Wash. Mining Engineer, Spokane, Wash. *Spokane, Wash.*

HAAS, NATHAN, E. M., 1898. Assistant Mining Engineer and Assayer, Quincy Mining Co., Hancock, Mich. Mining Engineer, Nelson, B. C. *Nelson, B. C.*

HARDENBURGH, LOUIS MARTIN, (A. B., Hillsdale, College), E. M., 1896. Instructor in Chemistry and Ore Dressing Michigan College of Mines. Mining Engineer Pewa-

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NAME. OCCUPATION. ADDRESS.

bic Co., Iron Mountain, Mich. Superintendent, Odanah Iron Co., Hurley, Wis. *Hurley, Wis.*

HARRIS, HERBERT JEAN, (B. S., University of Wisconsin), E. M., 1894. Engineer, Illinois and Mississippi Canal. Engineer, Double Track Work, Madison Division, Chicago and Northwestern Railway. Assistant Engineer, C. & N. W. Ry., Evansville, Wis. Assistant Engineer, Union Pacific R. R., Kansas Division. *Kansas City, Mo.*

HARRIS, JOHN LUTHER, B. S., 1888. Surveyor, Quincy and Torch Lake Railroad. Special course, Massachusetts Institution of Technology, Boston, Mass. Assistant, and later Chief Mining Engineer, Quincy Mine, Hancock, Mich. Assistant Superintendent, Quincy Mine, Hancock, Mich. Superintendent, Quincy Mine, Hancock, Mich. *Hancock.*

HARTMANN, FREDERICK WILLIAM, B. S., E. M.,, 1900. With James P. Edwards, City Engineer. Civil Engineering and Surveying, Houghton, Mich. With R. C. Pryor, Surveying, Houghton, Mich. Assistant Engineer, Wolverine and Mohawk Mining Companies, Kearsarge, Mich. Mining Engineer, Mohawk and Wolverine Mining Companies, Kearsarge, Mich. *Kearsarge.*

HAYES, RUPERT PRATT, B. S., E. M., 1901. County Surveyor and Engineer with Hunter Mining Co., Wallace, Idaho. Mining Engineer, Johannesburg, S. A. *London, Eng.*

HERBERT, CHARLES ARTHUR, B. S., E. M., 1901. Assistant Engineer, Isle Royale Mining Co., Houghton, Mich. Engineer, Chicago, Wilmington and Vermillion Coal Co., Chicago, Ill. *Streator, Ill.*

HILLYER, VIRGIL SEBRING, E. M., 1899. With Manila Iron Co., Iron Mountain, Mich. With Chapin Mine, Iron

tendent with Ca. Minera de Penoles, Mapimi, Mex. Examining Mining Property, Congress Junction, Ariz. Mining Engineer and Assayer, Martinez, Ariz.
Martinez, Ariz.

Hopkins, Clarence Victor, E. M., 1901 Geologist and Topographer with the Geological and Topographical Survey of Northern Minnesota. Practical Miner and Timberman with the Amalgamated Copper Co., Butte, Mont. Sampler for the Silver Bow Amalgamated Copper Co., Butte, Mont. Hopkins & Holley, Civil and Mining Engineers, Assayers, United States Deputy Mineral Surveyors, Lewistown, Mont. *Butte, Mont.*

Honnold, William Lincoln, E. M., 1895. Assistant Superintendent, Mahoning Ore Co., Hibbing, Minn. Superintendent of Mines, California Exploration Co., San Andreas, Cal. Consulting Engineer, The Consolidated Mines Selection Co., Ltd., 310 Pine St. San Francisco, Cal. Consulting Engineer, The Consolidated Mines Selection Co., Ltd., and Messrs. A. Dunkelsbuhler & Co., 3, Throgmorton Avenue, London, Eng.
P. O. Box 2269, Johannesburg, S. A.

NAME. OCCUPATION. ADDRESS.

JOHNSON, OSCAR MARTIN, B. S., E. M., 1901. Mining Engineer, Loretto Mich. Assistant Superintendent, Eleanor Iron Co., Loretto Mch. *Loretto.*

JONES, MAURICE LINDLEY, E. M.,1894. Transit man for Government Engineers, Eastern Division, Hennepin Canal, Bureau, Ill. Inspector, Illinois and Mississippi Canal. Surveyor and Draughtsman, with W. H. Leffingwell, Civil and Mining Engineer, Cripple Creek, Colo. Mining Engineer, Jones & Arnold. *Cripple Creek, Colo.*

KENT, BAMLET, B. S., E. M., 1896. Inspector, United States Engineers, Portage Lake Ship Canals, Houghton, Mich. U. S. Junior Engineer, U. S. A., Detroit, Mich. *Detroit.*

KIRCHEN, JOHN GEORGE, E. M., 1894. Assistant Surveyor Trap Rock River Railroad. Assistant Mining Engineer, Quincy Mine, Hancock, Mich. Mining Engineer, Arcadian Copper Co., Arcadian Mine, Mich. Mining Engineer, Globe Engineering Co., San Francisco, Cal. Mining Engineer, Mountain Copper Co., Keswick, Cal. General Engineer, Shannon Copper Co., Clifton, Ariz. Superintendent, Coronado Mining Co., Clifton, Ariz. *Clifton, Ariz.*

KIRK, MARCUS EUGENE, E. M., 1893. Mining Engineer and Prospector, Aurania, Lumpkin Co., Ga. Electrical Engineer Missouri and Kansas Telephone Co., Kansas City, Mo. (*Deceased* 1899.)

KNIGHT, JOHN ALEXANDER, E. M., 1894. Chemist, Illinois Steel Co., Chicago, Ill. Assistant Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Assistant, Engineering Corps, Lake Shore and Michigan Southern, and Chicago, Rock Island and Pacific Railways, Track Elevation, Chicago, Ill. Mining En-

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NAME. OCCUPATION. ADDRESS.

neer, Specialty, Development of Mesabi Iron Lands, Minn. *Hibbing, Minn.*

LYMAN, ROBERT, JR., B. S., E. M., 1900. Assistant Engineer, War Eagle and Centre Star Mining Cos., Rossland, B. C. Mining Engineer, Ferguson, B. C. Assistant Engineer, Tonopah Mining Co., Tonopah, Nev. Assistant Engineer, Water Works Department, Illinois Central R. R. Co., Chicago, Ill. *Chicago, Ill.*

MAAS, ARTHUR EUGENE, B. S., E. M., 1899. With J. M. Longyear, Marquette, Mich. Mining Engineer, Shannon Copper Co., Clifton, Ariz. *Negaunee.*

MAAS, WALTER LEO, B. S., E. M., 1899. Mining Engineer for the British Gold Mines Co., Ltd., London, and Mexico Venture Syndicate, Ltd., Mexico City, Mex. Consulting Mining Engineer, St. Paul, Minn. *St. Paul, Minn.*

MACLEOD, THOMAS LEBRETON, B. S., 1902. Assistant in Physics and Mining Engineering, Michigan College of Mines *Houghton.*

MARTIN, NICHOLAS JOHN, B. S., E. M., 1895. Oiler and Lighter, Drake and Stratton, Oliver Mine, Virginia, Minn. Conductor on Stripping Train, Oliver Mine. Timekeeper, Canton Mine, Biwabik, Minn. Assistant Engineer to City Engineer and to Engineer for Consolidated Mining Co. on Mesabi Range, Minn. Assayer, Fort Steele, B. C. Engineer and Assayer for California Exploration, Ltd., San Andreas, Cal. Engineer and Assayer, Evans-Van Hecke Mining Co., Evans Point, Ariz. Assistant Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. Mining Engineer, United Globe Mines, Globe, Ariz. Mining Engineer for the New York and Honduras Rosario Mining Co., Rosario. *Rosario, San Juancito, Honduras.*

Houghton Mich., Assistant Mining Engineer, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. Assistant Surveyor, Isle Royale Co., Isle Royale, Mich. Assistant Surveyor, Atlantic and Salmon Trout River Railroad, Atlantic Mine, Mich. Assistant Surveyor with J. P. Edwards, C. E., Houghton, Mich. Sub-Inspector, United States Engineers, Portage Lake Ship Canals. (*Deceased*).

McFarlane, George Campbell, E. M., 1894. Mining Engineer, Lemhi Mining Co., Gibbonsville, Idaho. Mining Engineer, Idaho Gold Reduction Co. Mining Engineer, Bingham Placer Mining Co., Gibbonsville, Idaho. Superintendent, Monolith Mining Co., Ltd., Shoup, Idaho. Superintendent, Exploration of the Tobico Coal Co. Lands, Bay City, Mich. Superintendent, Wenona Coal and Mining Co., Bay City, Mich. Superintendent, Sun Dance Mine, Prescott, Ariz. Engineer, Hecla Coal and Cement Co., Bay City, Mich. *Bay City.*

McIntyre, Edward Eugene, E. M., 1902. Mining Engineer for United States Steel Corporation at Hibbing, Minn. *Hibbing, Minn.*

Engineer for the Menominee Exploring Co., and Superintendent for the Canadian Explorations, Pickands, Mather & Co., Cleveland, Ohio. Superintendent of Sparta and Malta Iron Cos., Sparta, Minn. Superintendent of Troy Mine, Eveleth, Minn. *Sparta, Minn.*

NEAL, ALVIN CAMPBELL, E. M., 1901. Mining Engineer Cripple Creek, Colo. *Cripple Creek, Colo.*

NEEL, CARR BAKER (B. S. University of Chicago), E. M. 1899. Assistant Manager, Sabina Mining Co., Sabina, via Quiriego, Sonora. Blast Furnace Foreman, Boston and Montana Smelter, Great Falls, Mont. Auditor, Boston-Wyoming Smelter, Power and Light Co., Grand Encampment, Wyoming. Assistant Manager, Gold Pan Mining Co., Breckenridge, Colo. Superintendent Oregon Smelting and Refining Co., Sumpter, Ore. *Sumpter, Ore.*

OKUBO, TOGO, B. S., 1899. Professor in Mechanical Engineering, Tokio Higher Technological School, Tokio, Japan. Consulting Engineer of Negishi Rolling Mill, Tokio, Japan. *Tokio, Japan.*

O'NEIL, FREDERICK WILLIAM, E. M., 1899. Assistant in Mechanical Engineering, Michigan College of Mines.

PARNALL, WILLIAM EDWARD, B. S., 1888. Superintendent Stamp Mill, National Mine, Ontonagon, Mich. Mining Engineer and Chemist, Champion Mine, Beacon, Mich. Electrical Engineering Course in Cornell University, Ithaca, N. Y. and Massachusetts Institute of Technology, Boston, Mass. In charge of the installation of the Electric Haulage Plant, Cleveland and Iron Cliffs Mining Co., Ishpeming, Mich. In charge of the Installation work for the Morgan Gardner Electric Co., Chicago, Ill. Electrical Engineer for Osborne, Seager & Co., West Newton, Pa. Assistant Superintendent of the Tamarack Mine, Calumet, Mich. *Calumet.*

PEACOCK, DAN C., E. M., 1898. Chemist for Commonwealth Iron Co., Commonwealth, Wis. Mining Engineer, Champion Iron Co., Beacon, Mich. *Beacon.*

PEARCE, HARRY A., B. S., E. M., 1902. Engineer and Chemist, Commonwealth Iron Co., Commonwealth, Wis. *Commonwealth, Wis.*

PEARCE, LOUIS CHESTER, B. S., E. M., 1901. Instructor in

Mich. Miner, Lake Superior Mine, Ishpeming, Mich. With R. J. Hosner, Romeo Door Hanger Co., Romeo, Mich. Conductor, West End Street Ry., Boston, Mass. Farmer, Lawtey, Florida. Clerk, Baltimore Dairy Lunch Co., Boston, Mass. Clerk, Canfield & Spier, Attorneys, Mt. Clemens, Mich. (*Deceased, 1899.*)

Remer, Emil Frederick, B. S., E. M., 1900. Assistant Engineer of Construction Redridge Dam, Redridge, Mich. Mining Engineer, Isle Royale Mining Co., Houghton, Mich. Engineer for Cole & McDonald Exploration Co., Virginia, Minn. Assistant Mining Engineer, Corrigan, McKinney & Co., on the Mesaba Range, Stevenson Mine, Hibbing, Minn. *Hibbing, Minn.*

Reynolds, Frederick Llewellyn, E. M., 1898. Chemist with Universal Fuel Co., Chicago, Ill. Chemist and Engineer, British Gold Mines of Mexico, Ltd., at Mina La Colorado. *Matape, via Ures, Mex.*

Richardson, Henry Harrison, B. S., E. M., 1901. Assistant to Superintendent of Buildings, Michigan College of Mines. Assistant Superintendent, Pinto Creek, Copper

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SHIELDS, JAMES WILSON, B. S., 1901. Assistant Superintendent, Tamarack-Osceola Consolidated Mining Co.'s Stamp Mills. Superintendent, Quincy Mining Co.'s Stamp Mills, Mason, Mich. *Mason.*

SLOCK, GEORGE, B. S., 1895; E. M., 1896. Assistant in Drawing, Michigan College of Mines. Inspector, L. S. & I. Ry., Marquette, Mich. Sub-Inspector, U. S. Engineers, Portage Lake Ship Canals, Houghton, Mich. Assistant Superintendent in Construction of Arcadian Stamp Mill, Hancock, Mich. Assistant Engineer, Tamarack and Osceola Consolidated Mines, Calumet, Mich. *Calumet.*

SMITH, KNOWLES BURDETTE, B. S., E. M., 1901. Geologist and Topographer on Hillyer's Geological and Topographical Survey of Northern Minnesota. Instructor in the Department of Geology and Mineralogy, Michigan College of Mines. Mining Engineer and Assayer, Prescott, Ariz. *Prescott, Ariz.*

SMITH, SAMUEL RUSSELL, B. S., 1902. Assistant Mining Engineer, Mass Consolidated Mining Co., Rockland, Mich. Engineer and Superintendent of Construction, Mass Mill. Assistant Mining Engineer, Mahoning Mine, Ely, Minn. Superintendent of Exploration, Mahoning Ore and Steel Co., on Vermilion Range, Ely, Minn. *Ely, Minn.*

SMITH, WARD BRAINARD, B. S., E. M., 1901. Assistant Engineer, Tennessee Coal, Iron and R. R. Co., Blocton, Ala. Civil Engineer, Railroad and Telephone Construction, Champion Lumber Co., Orvisburg, Miss. *Orvisburg, Miss.*

SMITH, WILLARD JOSEPH, B. S., E. M., 1899. Mining Engineer, Wolverine and Mohawk Copper Mines. Assistant Superintendent, Wolverine and Mohawk Copper Mines, Kearsarge, Mich. *Kearsarge.*

SNELL, HENRY VINCENT, B. S., 1898; E. M., 1899. Assistant Engineer, War Eagle and Centre Star Mining Cos.,

SUTTON, WILLIAM JOHN, B. S., E. M., 1898. Instructor in Mineralogy and Petrography, Michigan College of Mines. Geologist and Consulting Engineer, Esquimault and Nanaimo Railway Co. *Victoria, B. C.*

THOMAS, JAMES ARTHUR, B. S., E. M., 1899. Transit man, Michigan Geological Survey, Houghton, Mich. Assistant Mining Engineer, Old Dominion Copper Mining and Smelting Co., Globe, Ariz. *Globe, Ariz.*

TOWER, LOUIS LOVELL, E. M., 1895. Sub-Inspector on Dredge, United States Engineers, Grosse Point, Mich. Mining Engineer, Cook's Inlet, Alaska. Deputy Mineral Surveyor, Northport, Wash. Mining Engineer, LeRoi Mining and Smelting Co., Northport, Wash. Civil and Mining Engineer, Colville, Wash. Mining Engineer, Northport, Wash. *Northport, Wash.*

TRENGOVE, SAMUEL REED, E. M., 1893. City Engineer, Red Jacket, Mich. Assayer, Tremont Gold Mining and Milling Co., Gould, Mont. Assayer, Diamond Hill Mining Co., St. Louis, Mont. Mining Engineer and Assayer.

Co. Assistant Engineer, Copper Range R. R. Co. Mining Engineer, Donora Mining Co., Palmer, Mich. Mining Engineer, Inter-State Iron Co., (Jones & Laughlin) Virginia, Minn. *Virginia, Minn.*

Van Orden, Frank Lyon, B. S., E. M., 1899. Mining Engineer, Wyandot Copper Co., Houghton, Mich. Superintendent, Wyandot Copper Co., Houghton, Mich. *Houghton.*

Wakefield, Arthur Albert, B. S., 1890. Mining Engineer, Fronteriza Silver Mining and Milling Co., Velardena, Mex. Mining Engineer, Hurley, Wis. Mining Engineer, Velardena, Mex. Mining Engineer, South McAlister, I. T. Mining Engineer, State of Chihuahua, Mex. Explorer, Gogebic Range. Engineer, Tilden Mine, Oliver Iron Mining Co., Bessemer, Mich. Manager of Look Out Mining Co.'s Properties at Niblack, Prince of Wales Island, Alaska. *Ketchikan, Alaska.*

Walker, Elton Willard, B. S., E. M., 1896. Assistant Engineer, Calumet and Hecla Mine, Calumet. Mining Engineer, Old Dominion Mining Co., Globe, Ariz. Chief Engineer, Tombstone Consolidated Mines Co., Ltd. As-

WRAITH, WILLIAM, E. M., 1894. Resident Engineer for Canon City Coal Co., Rockvale, Colo. Engineer for Vulcan Fuel Co., at Newcastle, Colo. Assistant Civil Engineer, Boston and Montana Consolidated Copper and Silver Mining Co., and Butte and Boston Mining Co. Civil Engineer, Boston and Montana Consolidated Copper and Silver Mining Co., and Butte and Boston Mining Co., Butte, Mont. Mechanical Engineer, Boston and Montana Consolidated Copper and Silver Mining Co., Butte, Mont. *Butte, Mont.*

WRIGHT, CHARLES WILLIAM, B. S., E. M., 1902. Instructor in Geology and Mineralogy, Michigan College of Mines. *Houghton.*

ZERTUCHE, YGNACIO MARIA, B. S., E. M., 1896. Mining Engineer, San Francisco Mine, Conception del Oro, Mex. *Zacatecas, Zac., Mex.*

Present Location of Graduates.

Alabama	4	Montana	11
Alaska	1	Nevada	1
Arizona	16	Ohio	1
British Columbia	5	Oregon	2
California	3	Peru	1
Colorado	10	Russia	1
Cuba	1	South Africa	4
France	1	South Dakota	1
Honduras	1	Texas	1
Idaho	1	Utah	10
Illinois	6	Washington	3
Japan	1	Wisconsin	5
Mexico	17	Wyoming	4
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Missouri	2	Total	202

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conflicts; that is, he must not choose two subjects which have common recitation or lecture period.

No hour table is given for the practice courses of the summe term, the practice work in Mine Surveying and Mining (R 3), nc the excursions to the mines, mills and field in the courses R (Principles of Mining), M 11 (Mechanical Engineering II.) an Y 1 (Principles of Geology). While pursuing any one of the practic courses the student devotes to it his whole time. The excursions i the other courses are arranged for while the courses are in progres Therefore no hour tables are necessary.

MAPS.

To make clear the fact of the location of the College of Min in the midst of active mining operations, two maps are shown.

The first gives a detailed exhibit of the Portage Lake Minin District, which forms the immediate vicinity of the College. Mo of the active copper mines within the territory covered by this ma are indicated on it.

The second is a general map of the mineral districts of th Upper Peninsula. It shows the various iron and copper range which are accessible from the College. No attempt has been mad to indicate the different mining districts of the Copper Range, nc ı of the Iron Ranges.

Explanation of Tables and Maps

TABLES.

Table I shows the term or terms in which each subject is taught, its proportionate credit in tenths of a unit, the number of times each week that the student must appear in class-room for recitation or lecture, and the total number of hours each week an average student is expected to pass upon the subject. This total includes both laboratory and study time with the class-room time. The time spent at the College includes both the recitation and laboratory hours.

Tables II, III, IV, and V show the particular hours in each week at which the student taking a given subject meets the instructor in the class-room for recitation or lecture.

These tables do not show the laboratory hours, which must be arranged with the instructors having charge of the work. These may differ widely for different students.

In choosing his subjects for any year the student must avoid conflicts; that is, he must not choose two subjects which have a common recitation or lecture period.

No hour table is given for the practice courses of the summer term, the practice work in Mine Surveying and Mining (R 3), nor the excursions to the mines, mills and field in the courses R 1 (Principles of Mining), M 11 (Mechanical Engineering II.) and Y 1 (Principles of Geology). While pursuing any one of the practice courses the student devotes to it his whole time. The excursions in the other courses are arranged for while the courses are in progress. Therefore no hour tables are necessary.

MAPS.

To make clear the fact of the location of the College of Mines in the midst of active mining operations, two maps are shown.

The first gives a detailed exhibit of the Portage Lake Mining District, which forms the immediate vicinity of the College. Most of the active copper mines within the territory covered by this map are indicated on it.

The second is a general map of the mineral districts of the Upper Peninsula. It shows the various iron and copper ranges which are accessible from the College. No attempt has been made to indicate the different mining districts of the Copper Range, nor the subdivisions of the Iron Ranges.

M

YEAR BOOK

OF THE

Michigan College of Mines

1903-1904

ANNOUNCEMENT OF COURSES FOR 1904-1905

HOUGHTON, MICHIGAN

PUBLISHED BY THE COLLEGE
JUNE, 1904

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A Register of Graduates, giving their occupations, is published separately and will be sent upon request.

BOARD OF CONTROL OF THE MICHIGAN COLLEGE OF MINES

	TERM EXPIRES
Walter Fitch, Beacon.	June 9, 1905
Horatio Stuart Goodell, Houghton,	June 9, 1905
Hon. John Monroe Longyear, Marquette,	June 9, 1907
William Edward Parnall, Calumet,	June 9, 1907
William Kelly, Vulcan,	June 9, 1909
James McNaughton, Calumet,	June 9, 1909

President of the Board of Control - - - - WALTER FITCH
Secretary of the Board of Control - - FRED WALTER MCNAIR

OFFICERS OF ADMINISTRATION

President.................................Fred Walter McNair
Secretary and Librarian...................Frances Hanna Scott
Treasurer...........................Frederick William Nichols
Superintendent of Grounds..........Frederick William Sperr
Superintendent of Buildings..................Ozni Porter Hood

OTHER EMPLOYEES

HENRY GIBBS,
Purchasing Agent and Supply Clerk.

MISS CLARA PENBERTHY,
Stenographer.

HARRY SHARP,
President's Secretary and Accountant.

THOMAS EMANUEL RICHARDS,
Engineer.

MAXIME MORIN,
Carpenter.

FREDERICK CHARLES STRASSER,
Chief Janitor.

Iron Mountain High School.
Ironwood High School.
Ishpeming High School.
Ithaca High School.
Janesville High School, Janesville, Wis.
Kalamazoo High School.
Kansas City Manual Training High School, Kansas City, Mo.
Lake Linden High School.
L'Anse High School.
Ludington High School.
Manistee High School.
Manistique High School.
Marquette High School.
Menominee High School.
Michigamme High School.
Michigan Military Academy.
Milwaukee Academy, Milwaukee, Wis.
Milwaukee East Side High School, Milwaukee, Wis.
Milwaukee South Side High School, Milwaukee, Wis.
Milwaukee West Side High School, Milwaukee, Wis.
Morgan Park Academy, Morgan Park, Ill.
Muskegon High and Hackley Manual Training Schools.
Negaunee High School.
Northwestern Military Academy, Highland Park, Chicago, Ill.
Norway High School.
Phœnix High School, Phœnix, Ariz.
Port Huron High School.
Racine College, Racine, Wis.
Reed City High School.
Republic High School.
Rockford High School.
Rutger's College Preparatory School, Princeton, N. J.
Ryan High School, Appleton, Wis.
Saginaw East Side High School.
Saginaw West Side High School.
St. Johns Military Academy, Delafield, Wis.
San Antonio Academy, San Antonio, Tex.
Sault Ste. Marie High School.
Shattuck School for Boys, Faribault, Minn.
Steele High School, Dayton, Ohio.

Butte Business College, Butte, Mont.
Calumet High School.
Caro High School.
Clio High School.
Cobb and Arms Classical School, Chicago, Ill.
Detroit Central High School.
Detroit Eastern High School.
Detroit Western High School.
Detroit Uniersity School.
Duluth High School, Duluth, Minn.
Edgerton High School, Edgerton, Wis.
Escanaba High School.
Ferris Institute, Big Rapids.
Flint High School.
Gladstone High School.
Grand Rapids Central High School.
Grass Lake High School.
Hadley High School.
Hancock High School.
Houghton High School.
Hyde Park High School, Hyde Park, Chicago, Ill.
Ionia High School.

A 2. Plane Trigonometry.

Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by, or accompanied with, A 1 (Algebra). Messrs. SIMPSON, ROOD, and HAIGLER.

A 3. Spherical Trigonometry.

Six times a week, five weeks. To count as three-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Professor FISHER and Mr. GRANT.

A 4. Analytical Geometry.

Four times a week, twenty-one weeks. To count as nine-tenths of a credit. To be preceded by A 2 (Plane Trigonometry). Messrs. SIMPSON, ROOD, and HAIGLER.

A 5. Differential and Integral Calculus.

Four times a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by A 4 (Analytical Geometry), and B 1 (Physics), and preceded by, or accompanied with, B 4 (Physics). Professor FISHER, Mr. GRANT and Mr. SIMPSON.

C. MECHANICS.

Professor Fisher and Mr. Grant.

C 1. Analytic Mechanics.
Three times a week, sixteen weeks. To count as five-tenths of a credit. To be preceded by, or accompanied with, A 5 (Calculus). Professor FISHER and Mr. GRANT.

C 2. Analytic Mechanics.
Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by C 1 (Analytic Mechanics). Professor FISHER and Mr. GRANT.

F. CHEMISTRY.

Professor Koenig and Dr. Fernekes, Dr. Smith, Dr. Niles and Mr. Wilson.

F 1. General Experimental Chemistry.
Twelve hours a week, twenty-eight weeks. To count as eleven-tenths of a credit. Professor KOENIG, Dr. NILES and Mr. WILSON.

F 2. Blowpipe Analysis.
Twelve hours a week, five weeks. To count as two-tenths of a credit. To be preceded by F 1 (General Experimental Chemistry). Professor KOENIG and Dr. SMITH.

F 3. Qualitative Analysis.
Twelve hours a week, twenty-eight weeks. To count as eleven-tenths of a credit. To be preceded by F 1 (General Experimental Chemistry) and F 2 (Blowpipe Analysis). Professor KOENIG and Dr. SMITH.

F 4. Volumetric Analysis.
Twelve hours a week, twelve weeks. To count as five-tenths of a credit. To be preceded by F 3 (Qualitative Analysis). Professor KOENIG and Dr. FERNEKES.

Professor Austin.

S. ORE DRESSING.

Professor Austin and Mr..............

S 2. Ore Dressing.

Two hours a week in class room, and *four hours a week* in Laboratory, sixteen weeks, winter term and first half of spring term. To count as four-tenths of a credit. To be preceded by Q 2 (Hydraulics), and W 3 (Mineralogy), and preceded by or accompanied with G 1 (Assaying). Professor Austin and ....

SG. Practice Work in Ore Dressing and Metallurgy.

Forty-five hours a week, six weeks, first half of summer term. Ore Dressing Mill, four weeks. Blast Furnace work, two weeks. To count as one credit. To be preceded by G 3 (Metallurgical Laboratory Practice) and S 2 (Ore Dressing). Professor Austin.

M. MECHANICAL ENGINEERING.

Professor Hood, Messrs. Christensen, DeLay, McGrath and Dodge.

M 2. Shop Practice.

Forty-five hours a week, twelve weeks. To count as two credits. Messrs. .... and McGrath.

M 14. Air Compression and Air Machinery.
Three times a week, ten weeks. To count as three-tenths of a credit. To be preceded by M 10 (Pumps and Pumping Machinery). Professor Hood.

M 3. Mechanism and Drawing.
Fifteen hours a week, eleven weeks. To count as six-tenths of a credit. To be preceded by M 1 (Properties of Materials), M 16 (Machine Drawing), and preceded by, or accompanied with, C 2 (Analytic Mechanics). Mr. Christensen.

M 12. Mechanical Engineering III.
Three times a week, twelve weeks. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), and preceded by, or accompanied with C 2 (Analytic Mechanics), and fall term of M 4 (Mechanics of Materials). Professor Hood.

M 13. Mechanical Engineering IV.
Three times a week, ten weeks. To count as three-tenths of a credit. To be preceded by M 12 (Mechanical Engineering III.). Professor Hood.

M 9. Mechanical Engineering Laboratory Practice.
Forty-five hours a week, six weeks. To count as one credit. To be preceded by M 13 (Mechanical Engineering IV.). Professor Hood and Mr. Christensen.

N. ELECTRICAL ENGINEERING.

Professor Hood and Mr. DeLay.

N 1. Electrical Engineering.
Three hours a week, twenty-three weeks. To count as seven-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), and B 1 and B 4 (Physics). Mr. DeLay.

N 3. Electrical Laboratory Practice.
Forty-five hours a week, six weeks. To count as one credit. To be preceded by N 1 (Electrical Engineering II.). Professor Hood and Mr. De Lay.

cipline.

It is the intention, therefore, to give the instruction in this department in such a manner as will make prominent those subjects or portions of subjects which will be of actual use to the student, and, later, to the engineer. The value of the study of mathematics in developing the power to do vigorous and logical thinking is not underestimated, but it is thought that the effort to master the logic of the subjects necessary to the engineer will afford the student ample opportunity to develop this power.

Every effort is made to see that the student takes advantage of the opportunity thus offered. At each step of his progress he is required to think. The ability to describe a given method, or to correctly quote a given formula, and to apply either to a given case, is in no instance accepted as sufficient. The student is required to logically derive the method or formula, and to demonstrate its correctness.

The courses offered in mathematics are the following:

A 1. Algebra.

Messrs. SIMPSON, ROOD and HAIGLER.

The course includes the Theory of Limits, Logarithms, Progressions, Binomial Theorem, Undetermined Co-efficients, Series and

work he is to pursue will lie with him. Text books are Nichol's Manual of Laboratory Physics, and Stewart and Gee's Elementary Practical Physics, Vols. I and III.

Twenty-four hours a week, last five weeks of the spring term. To count as four-tenths of a credit.

B 3. Electrical Measurements.

Professor FISHER.

The increasing use of electricity in mining and related industries has caused the Michigan College of Mines to give particular attention to this subject.

This course is offered to those who are making Electrical Engineering their principal subject, to those who intend taking up Electrolytic or Electro-metallurgical work, and to any others who wish to become familiar with those modern methods of electrical measurement necessary wherever there is made any practical application of this agent.

In the course are included the measurement of Current, Resistance, Potential Difference, Electromotive Force, Quantity, Capacity, Mutual and Self Induction, Strength of Field, etc.

Professor Fisher and Mr. Grant.

An attempt is made in Mechanics to develop the essential principles, and to render the student proficient in applying them to practical rather than theoretical problems. To this end a large number of problems are solved which, so far as possible, are selected from machines or structures with which the student is already familiar, or the study of which he is subsequently to take up.

C 1. Analytic Mechanics.

Professor Fisher and Mr. Grant.

Church's Mechanics of Engineering, Parts I and II, Statics and Dynamics, is made the basis of this and the following course.

Subject C 1 occupies three hours in class room and three in the Laboratory each week for sixteen weeks, in the winter and spring terms. To count as five-tenths of a credit.

To be preceded by B 1 (Physics), and preceded by, or accompanied with A 5 (Calculus).

C 2. Analytic Mechanics.

Professor Fisher and Mr. Grant.

Subject C 2 continues the work begun in C 1, and is given three hours in class room and three in the laboratory each week, twelve weeks, in the fall term. To count as four-tenths of a credit.

To be preceded by C 1 (Analytic Mechanics).

F. CHEMISTRY.

Professor Koenig, and Dr. Fernekes, Dr. Smith, Dr. Niles and Mr. Wilson.

The instruction in Chemistry is designed to excite in the student a love for experimentation and to train him to inductive thinking. If this aim can be reached, or if it can only be approximated, it is

tion, including hoisting engines, air compressors, pumps and boilers of many kinds. So far as possible these opportunities are used in preference to the college equipment.

M 10. Pumps and Pumping Machinery.

Professor Hood.

Three times a week, twelve weeks, fall term. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineering II.), and preceded by, or accompanied with C 2 (Analytic Mechanics).

Discussion of pump problems and of pump details, such as pistons, plungers, and methods of packing them; size of suction and delivery pipes, air and vacuum chambers, etc. Types of pumps—force pumps, crank and fly wheels, direct acting, duplex, compound and triple expansion pumps, fire, mine, rotary, centrifugal, and high duty pumps. Duty trials of pumps. Barr's Pumping Machinery, and lectures.

M 11. Mechanical Engineering II.

Professor Hood.

Fifteen hours a week, first five weeks of spring term. To count as three-tenths of a credit. To be preceded by M 5 (Mechanical Engineering I.), M 16 (Machine Drawing), M 1 (Properties of Materials of Engineering) and M 2 (Shop Practice). The same text book is completed, some subjects being amplified by lectures.

The very extensive and varied power plant equipments in the immediate neighborhood will be used as illustrative material to familiarize the student with the details introduced into the course. Trips of inspection will be taken and reports required.

Questions raised in these general courses (M 5 and M 11) are specially treated at length in subjects M 9, M 10, M 12, M 13, M 14, M 3 and parts of Q 2 and R 2.

M 12. Mechanical Engineering III.

Professor Hood.

Three times a week, twelve weeks, fall term. To count as four-tenths of a credit. To be preceded by M 11 (Mechanical Engineer-

Fitch, Richard Smithson,	*Warrensburg, Mo.*
Hunt, Robert Courtney,	*Houghton.*
McCausland, George William,	*Saginaw.*
Merrell, Millard Clinton,	*Oakland, Cal.*
Sherburne, E. Bertrand,	*Chicago, Ill.*
Swift, Heman Leigh,	*Hamden, Conn.*
Worcester, David Dows,	*Detroit.*
Zarate, Jose Cecilio,	*Guadalajara, Mex.*

Kentucky	1
Mexico	1
Michigan— { Upper, 80 / Lower, 72 }	152
Minnesota	16
Missouri	3
New York	4
North Carolina	1
Ohio	4
Oregon	1
Pennsylvania	3
Scotland	2
Texas	1
Washington	1
Wisconsin	13
Total	231

Average Age of Students, 1903-04 .... 22¾ years

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